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ERRATA NOTICE

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The following change pages have been incorporated into the subject document (attached):

3-3 (Figure 3.1.1-2)

3-16 (Internetworking Subsystem)

3-28 (Table 3.4.1-1)

3-29 (Section 3.4.1.1)

3-31 (Figure 3.4.2-1)

3-43 (Section 3.4.2.2.2)

3-62 through 3-63 (Section 3.4.6.2)

3-82 (Section 3.4.2.8.2)

If you have any questions, please contact our Data Management Office at (301) 925-0322.

EOSDIS Core System Project

Release A LaRC DAAC Design Specification for the ECS Project

July 1995

Hughes Information Technology Corporation
Landover, Maryland

Release A LaRC DAAC Design Specification for the ECS Project

July 1995

Prepared Under Contract NAS5-60000
CDRL Item 046

APPROVED BY

Parag Ambardekar /s/	7/28/95
Parag Ambardekar, Release A CCB Chairman	Date
EOSDIS Core System Project	

Hughes Information Technology Corporation
Landover, Maryland

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Preface

This document is one of sixteen comprising the detailed design specifications of the SDPS and CSMS subsystem for Release A of the ECS project. A complete list of the design specification documents is given below. Of particular interest are documents number 305-CD-004, which provides an overview of the subsystems and 305-CD-018, the Data Dictionary, for those reviewing the object models in detail. A Release A SDPS and CSMS CDR Review Guide (510-TP-002) is also available.

The SDPS and CSMS subsystem design specification documents for Release A of the ECS Project include:

305-CD-004	Release A Overview of the SDPS and CSMS Segment System Design Specification
305-CD-005	Release A SDPS Client Subsystem Design Specification
305-CD-006	Release A SDPS Interoperability Subsystem Design Specification
305-CD-007	Release A SDPS Data Management Subsystem Design Specification
305-CD-008	Release A SDPS Data Server Subsystem Design Specification
305-CD-009	Release A SDPS Ingest Subsystem Design Specification
305-CD-010	Release A SDPS Planning Subsystem Design Specification
305-CD-011	Release A SDPS Data Processing Subsystem Design Specification
305-CD-012	Release A CSMS Segment Communications Subsystem Design Specification
305-CD-013	Release A CSMS Segment Systems Management Subsystem Design Specification
305-CD-014	Release A GSFC Distributed Active Archive Center Design Specification
305-CD-015	Release A LaRC Distributed Active Archive Center Design Specification
305-CD-016	Release A MSFC Distributed Active Archive Center Design Specification
305-CD-017	Release A EROS Data Center Distributed Active Archive Center Design Specification
305-CD-018	Release A Data Dictionary for Subsystem Design Specification
305-CD-019	Release A System Monitoring and Coordination Center Design Specification

In a few instances, graphics presented in this document have been exported directly from DBMS tools and may contain too much detail to be easily readable within hard copy page constraints. The reader is encouraged to view these drawings on line using the Portable Document Format (PDF) electronic copy available via the ECS Data Handling System (ECS) at URL http://edhs1.gsfc.nasa.gov.

This document is a contract deliverable with an approval code 2. As such, it does not require formal Government approval, however, the Government reserves the right to request changes within 45 days of the initial submittal. Once approved, contractor changes to this document are handled in accordance with Class I and Class II change control requirements described in the EOS Configuration Management Plan, and changes to this document shall be made by Document Change Notice (DCN) or by complete revision.

Any questions should be addressed to:

Data Management Office
The ECS Project Office
Hughes Information Technology Corporation
1616 McCormick Drive
Landover, MD 20785

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Abstract

The Release A Langley Research Center (LaRC) Distributed Active Archive Center (DAAC) Design Specification describes the ECS subsystems at the LaRC ECS DAAC. ECS Subsystem-Specific Design Specifications provide detailed design descriptions of the subsystems. This document shows the specific implementation of that design at the LaRC ECS DAAC, including the identification of the specific software, hardware and network configuration for the LaRC ECS DAAC.

Keywords: LaRC, DAAC, LaRC DAAC, DAAC Configuration, DAAC design

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Change Information Page

List of Effective Pages	
Page Number	**Issue**
Title	Original
iii through viii	Original
1-1 through 1-4	Original
2-1 through 2-4	Original
3-1 through 3-66	Original
4-1 through 4-3	Original
AB-1 through AB-7	Original

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Contents

Preface

Abstract

Change Information Page

1. Introduction

2. Related Documentation

3. LaRC DAAC Configuration

4. Future Releases

Figures

Tables

Abbreviations and Acronyms

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1. Introduction

1.1 Identification

This Release A LaRC DAAC Implementation/Design Specification for the ECS Project, Contract Data Requirement List (CDRL) Item 046, with requirements specified in Data Item Description (DID) 305/DV2, is a required deliverable under the Earth Observing System Data and Information System (EOSDIS) Core System (ECS), Contract NAS5-60000.

1.2 Scope

Release A of ECS supports the early operational stages of the Tropical Rainfall Measuring Mission (TRMM). The Release A follows an earlier ECS delivery, referred to as Interim Release 1 (IR1), which provided certain enterprise infrastructure in preparation for down stream deliveries. IR1 also provided science software integration and testing capabilities. The infrastructure delivery of ECS, involves four Distributed Active Archive Centers, these being the Goddard Space Flight Center (GSFC), the Marshall Space Flight Center (MSFC), the Langley Research Center (LaRC), and the EROS Data Center (EDC). Even though, only three of the DAACs (GSFC, MSFC and LaRC) directly support the TRMM effort all four are updated to the TRMM level at Release A to simplify configuration management and to allow for interface testing for future ECS releases. For Release A, the IR1 configurations of GSFC, MSFC and LaRC are updated with major hardware and software deliveries while EDC, which is not part of TRMM operations, receives a minor update to support interface testing.

This document is part of a series of documents comprising the Science and Communications Development Office design specification for the Communications and System Management segment (CSMS) and the Science and Data Processing Subsystem (SDPS) for Release A. The series of documents include an overview, a design specification document for each subsystem, and a design implementation document for each DAAC involved in the release, as well as one for the System Monitoring and Control (SMC) center.

This document specifically focuses on the LaRC DAAC ECS configuration and capabilities at Release A. It is released in, and reviewed at the formal Release A Critical Design Review.

This document reflects the June 21, 1995 Technical Baseline maintained by the contractor configuration control board in accordance with ECS Technical Direction No. 11, dated December 6, 1995.

1.3 Purpose

The Release A LaRC Implementation Specification establishes the LaRC DAAC ECS configuration and capabilities at Release A. These capabilities are selected from two ECS design segments referred to as the Science Data Processing Segment (SDPS) and the Communications and Systems Management Segment (CSMS). More specifically, this document addresses how the LaRC Release A version of SDPS will provide the hardware, software, and operations to:

- receive, process, archive and manage data from the Tropical Rainfall Measuring Mission;
- receive, archive and manage ancillary data required by the Release A science software;
- receive, archive and manage in situ correlative data;
- provide the Earth science community with access to data held by the ECS and the data products resulting from research using these data;
- promote exchange of data and research results within the science community and across the multi-agency/multi-national data collection systems and archives; and
- facilitate development, experimental usage, and community acceptance of new and/or improved science software for computing geophysical parameters from remotely sensed data.

Likewise, this document addresses how the LaRC Release A version of CSMS will provide the hardware, software, and operations to:

- interface with Nascom Operation Local Area Network (NOLAN) for the ingest of Level 0 TRMM data at Marshall Space Flight Center (MSFC) and Langley Research Center (LaRC);
- provide EOSDIS Science Network (ESN) links among the Release A Distributed Active Archive Centers (DAACs) and Goddard Space Flight Center (GSCF) mission operations and monitoring centers and National Oceanic Atmospheric Administration (NOAA) to support exchange and archive of mission-related science products, and ancillary data sets required by SDPS; and
- support status exchange between TRMM sites, and the DAACs for both operational and test efforts.

The purpose of this document is to show the elements of the Release A ECS science data processing and communications design and implementation that will support the LaRC ECS DAAC in meeting its objectives. The Release A Overview of SDPS and CSMS (305-CD-004-001) provides an overview of the ECS subsystems and should be used by the reader in order to get a basic understanding of ECS design components. The Release Plan Content Description document (222-TP-003-005) provides a detailed mapping of functional capabilities and services that will be available for each release. While some DAAC configurations vary depending on the mission/capability requirements for ECS at their DAAC, the LaRC DAAC at full ECS capability will include all of the ECS science data processing and communications subsystems. These include identification of and support for mission operations, as was as TRMM, AM-1 interface testing, Version 0 data migration, and V0 interoperability.

1.4 Status and Schedule

This submittal of DID 305/DV2 meets the milestone specified in the Contract Data Requirements List (CDRL) for Critical Design Review (pre-CDR) of NASA Contract NAS5-60000. The submittal will be reviewed during the Release A (CDR) and changes to the design which resulted from that review will be reflected in subsequent updates. The CDR may trigger follow-up actions in response to Review Item Discrepancies (RID) the results of which will be incorporated into the Test Readiness Review (TRR) version of this document.

1.5 Document Organization

This document is organized to describe the design of ECS at the LaRC DAAC as follows:

Section 1 provides information regarding the identification, scope, status and schedule, and organization of this document.

Section 2 provides a listing of the related documents which were used as source information for this document.

Section 3 provides a description of the ECS design at the LaRC DAAC. It includes a description of the DAAC external interfaces, ECS software implementation, including identification of Off the Shelf (OTS) products, hardware configuration and operational activities.

- Subsection 3.1 establishes the context for the technical discussions with an overview of the specific LaRC ECS DAAC mission and LaRC Release A operations. It identifies the key ECS related mission and operations activities that are supported via the ECS functionality at the DAAC.
- Subsection 3.2 addresses the external interfaces of the ECS subsystems as implemented at LaRC ECS DAAC. Major interfaces include those with the SDPF, Version 0 DAACs, and the CERES, MISR, and MOPITT Scientific Computing Facilities (SCF).
- Subsection 3.3 provides a software component analysis. There are 10 ECS data processing and communications subsystems that contain Hardware Configuration Items (HWCIs) and Computer Software Configuration Items (CSCIs). This section addresses the CSCIs and their corresponding lower level Computer Software Components (CSCs). The CSCs are described in detail in their respective subsystem design specification documents. In this section, the CSCs are captured in a single table, broken down by Subsystem/CSCI. The table lists the CSCIs and the associated CSCs. Notes are provided to expand upon generic explanations from the body of the Subsystem Design Specifications to describe what makes the particular CSC specific to the DAAC. In addition, when a CSC is identified as Off-the-shelf (OTS), the candidate product is identified.
- Subsection 3.4 provides a DAAC specific discussion of the ECS data processing and communications Hardware Configuration Items (HWCIs). This section identifies the HWCI components and indicates the specific components and quantities that are resident at the DAAC. It includes the Local area network (LAN) configuration and the rationale for the specific hardware configuration.
- Subsection 3.5 provides a software to hardware configuration mapping.

Section 4 gives a description of what can be expected in the next release of ECS.

The section, Abbreviations and Acronyms, contains an alphabetized list of the definitions for abbreviations and acronyms used in this document.

2. Related Documentation

2.1 Parent Documents

The parent documents are the documents from which the scope and content of this Release A LaRC DAAC Design Specification is derived.

194-207-SE1-001	System Design Specification for the ECS Project
305-CD-002-002	Science Data Processing Segment (SDPS) Design Specification for the ECS Project
305-CD-003-002	Communications and System Management Segment (CSMS) Design Specification for the ECS Project, Preliminary
305-CD-004-001	Release A Overview of the SDPS and CSMS System Design Specification for the ECS Project
305-CD-005-001	Release A SDPS Client Subsystem Design Specification for the ECS Project
305-CD-006-001	Release A SDPS Interoperability Subsystem Design Specification for the ECS Project
305-CD-007-001	Release A SDPS Data Management Subsystem Design Specification for the ECS Project
305-CD-008-001	Release A SDPS Data Server Subsystem Design Specification for the ECS Project
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305-CD-012-001	Release A CSMS Communications Subsystem Design Specification for the ECS Project
305-CD-013-001	Release A CSMS Systems Management Subsystem Design Specification for the ECS Project
305-CD-018-001	Release A Data Dictionary for Subsystem Design Specification for the ECS Project

2.2 Applicable Documents

The following documents are referenced within this Specification, or are directly applicable, or contain policies or other directive matters that are binding upon the content of this document.

206-CD-001-002	Version 0 Analysis Report for the ECS Project
209-CD-001-001	Interface Control Document Between EOSDIS Core System (ECS) and the NASA Science Internet
209-CD-002-001	Interface Control Document Between EOSDIS Core System (ECS) and ASTER Ground Data System
209-CD-003-001	Interface Control Document Between EOSDIS Core System (ECS) and EOS-AM Project for AM-1 Spacecraft Analysis Software
209-CD-004-001	Data Format Control Document for the Earth Observing System (EOS) AM-1 Project Data Base
209-CD-005-002	Interface Control Document Between EOSDIS Core System (ECS) and Science Computing Facilities (SCF)
209-CD-006-002	Interface Control Document Between EOSDIS Core System (ECS) and National Oceanic and Atmospheric Administration (NOAA) Affiliated Data Center (ADC)
209-CD-007-002	Interface Control Document Between EOSDIS Core System (ECS) and TRMM Science Data and Information System (TSDIS)
209-CD-008-002	Interface Control Document Between EOSDIS Core System (ECS) and the Goddard Space Flight Center (GSFC) Distributed Active Archive Center (DAAC)
209-CD-009-002	Interface Control Document Between EOSDIS Core System (ECS) and the Marshall Space Flight Center (MSFC) Distributed Active Archive Center (DAAC)
209-CD-010-001	Interface Control Document Between EOSDIS Core System (ECS) and the Langley Research Center (LaRC) Distributed Active Archive Center (DAAC)
209-CD-011-002	Interface Control Document Between EOSDIS Core System (ECS) and the Version 0 System
304-CD-002-001	SDPS Requirements Specification for the ECS Project
305-CD-014-001	Release A GSFC DAAC Design Specification for the ECS Project
305-CD-016-001	Release A MSFC DAAC Design Specification for the ECS Project
305-CD-017-001	Release A EROS Data Center DAAC Design Specification for the ECS Project

305-CD-019-001	Release A System Monitoring and Coordination Center Design Specification for the ECS Project
313-CD-004-001	Release A CSMS/SDPS Internal Interface Control Document for the ECS Project
604-CD-001-004	Operations Concept for the ECS Project: Part 1-- ECS Overview
604-CD-003-001	Operations Concept for the ECS Project: Part 2A -- ECS Release A
605-CD-001-001	Release A Operations Scenarios, Preliminary
420-WP-003-001	SDPS Storage Technology Insertion Plan
160-TP-004-001	User Pull Analysis Notebook [for the ECS Project]
210-TP-001-003	Technical Baseline for ECS Project
222-TP-003-006	Release Plan Content Description for the ECS Project
420-TP-001-005	Proposed ECS Core Metadata Standard Release 2.0, Technical Paper
423-41-03	Goddard Space Flight Center, EOSDIS Core System (ECS) Contract Data Requirements Document
none	Goddard Space Flight Center, Science Data Plan for the EOS Data and Information System covering EOSDIS Version 0 and Beyond

2.3 Information Documents Not Referenced

The following documents, although not referenced herein and/or not directly applicable, do amplify and clarify the information presented in this document. These documents are not binding on the content of the DAAC implementation specification.

205-CD-002-002	Science User's Guide and Operations Procedure Handbook for the ECS Project. Part 4: Software Developer's Guide to Preparation, Delivery, Integration, and Test with ECS
333-CD-003-001	SDP Toolkit Users Guide for the ECS Project
194-302-DV2-001	ECS Facilities Plan for the ECS Project
101-303-DV1-001	Individual Facility Requirements for the ECS Project, Preliminary
601-CD-001-004	Maintenance and Operations Management Plan for the ECS Project
608-CD-001-002	ECS Operations Plan for Release B of the ECS Project
101-620-OP2-001	List of Recommended Maintenance Equipment for the ECS Project
193-801-SD4-001	PGS Toolkit Requirements Specification for the ECS Project
828-RD-001-002	Government Furnished Property for the ECS Project

222-TP-003-006	Release Plan Content Description for the ECS Project
430-TP-001-001	SDP Toolkit Implementation with Pathfinder SSM/I Precipitation Rate Algorithm, Technical Paper
440-TP-001-001	Science Data Server Architecture Study [for the ECS Project]
420-TD-001-001	ECS Data Server Taxonomy Technical Description [for the ECS Project]
423-16-01	Goddard Space Flight Center, Data Production Software and Science Computing Facility (SCF) Standards and Guidelines
423-41-02	Goddard Space Flight Center, Functional and Performance Requirements Specification for the Earth Observing System Data and Information System (EOSDIS) Core System
540-022	Goddard Space Flight Center, Earth Observing System (EOS) Communications (Ecom) System Design Specification
560-EDOS-0211.0001	Goddard Space Flight Center, Interface Requirements Document Between EDOS and the EOS Ground System (EGS)

3. LaRC DAAC Configuration

3.1 Introduction

3.1.1 LaRC DAAC Overview

The LaRC Distributed Active Archive Center (LaRC DAAC) is one of the nine DAACs that are part of the NASA Earth Observing System Data and Information System (EOSDIS). These DAACs are organized to support specific scientific disciplines. The objective of the LaRC DAAC is to archive science data and provide support services to its users in the discipline areas of radiation budget, clouds, aerosols, and tropospheric chemistry.

The requirements to support the following activities have driven the design of the LaRC ECS DAAC: the TRMM Mission, EOS AM-1 interface testing, the Version 0 to Version 1 transition, interoperability, data flow and end-to-end testing and simulation readiness testing. The Release Plan provides a description of the missions and the driving requirements that must be satisfied to support these activities. This document provides a description of the ECS design components that are specific for the LaRC ECS DAAC. This document also elaborates upon design-generic components that are of special interest to the LaRC users, data producers, and DAAC staff.

A major design driver that shaped the design for the LaRC ECS DAAC is the requirement to support the TRMM CERES mission. During TRMM Release, the LaRC ECS DAAC must support the CERES science software integration and testing of their Version 1 and Version 2 science software (the CERES nomenclature is Release 1 and Release 2 respectively). Additional requirements are to support the ingesting of the TRMM CERES Level 0 data, the ingesting of ancillary data for the TRMM CERES data processing, the TRMM CERES data processing, the scientific quality assurance performed by the CERES science team and the CERES data management team, and the distribution of the CERES data to the science community. Additionally, the LaRC ECS DAAC must support the MISR and MOPITT science software integration and testing of their respective beta release and Release 1.

Another significant driver of the LaRC-specific design is the LaRC Version 0 activities. The lessons learned from the LaRC Version 0 activities are guiding the planning for the Version 0 to Version 1 transition. The goal of the LaRC Version 0 DAAC was prototyping in areas with high technical risk for Version 1. One labor- and time-intensive area is the use of the HDF data format. Another area is the ingesting, archiving, and distributing data associated with many different types of research projects (e.g. ERBE, SAGE II, field campaigns like FIRE). The LaRC Version 0 DAAC established an archive composed of multiple media types (e.g. optical WORM platters, optical rewritable disks, one-off CD-ROM, 3480 tapes). The LaRC Version 0 DAAC developed, in close concert with the LaRC User Working Group, an information management system. The LaRC Version 0 DAAC integrated and continues to enhance the ERBE project's multiple-satellite, multiple instrument data processing system. The ECS designers are carefully considering each of these contributions. A description of these contributions is provided in the Version 0 Analysis Report.

In preparation for the TRMM Mission, an early release of ECS (Interim Release 1) will be made available to support early TRMM interface testing. The equipment and software suites will be augmented as part of the implementation of Release A which is provided to support the TRMM Mission, Landsat 7 early interface testing, EOS AM-1 interface testing, science software I&T, data flow and end-to-end testing and simulation readiness testing. The Release Content Plan provides a description of the missions and the driving requirements which must be satisfied to support these missions. In the Release A time frame, the LaRC ECS DAAC will support ingest, processing, archive and distribution of data products from the CERES instruments flown onboard the TRMM observatory. In addition, the LaRC ECS DAAC will also support interface testing, data flow and end-to-end testing and simulation readiness testing missions. In order to support the EOSDIS ongoing missions, parallel operation of the DAAC Version 0 system and the ECS Release A will occur to ensure full access to existing datasets and services.

Figures 3.1.1-1 and 3.1.1-2 illustrate the SDPS and CSMS subsystems and their components for Releases A and B. The bulk of this document focuses on the selected elements of the ECS design that are use to achieve Release A objectives at the DAAC. Section 2.1 of this document identifies CDR Design Specifications which provide detailed information on each subsystem.

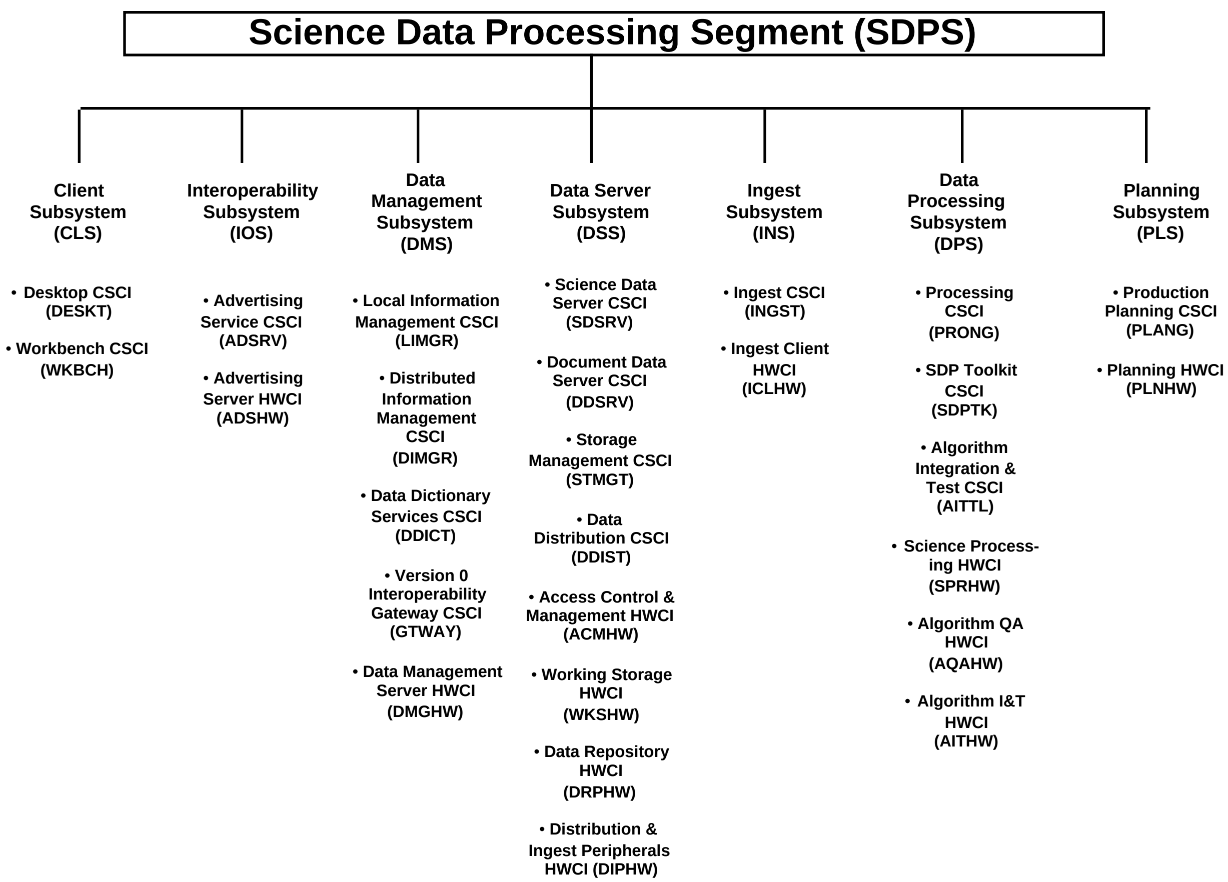

Figure 3.1.1-1. SDPS Subsystems and Configuration Items

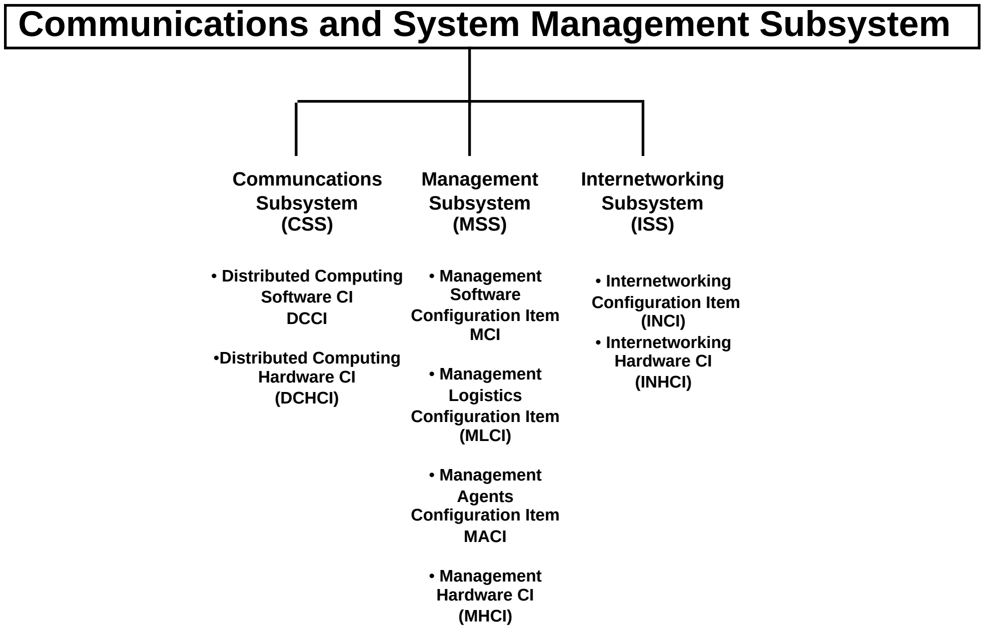

Figure 3.1.1-2. CSMS Subsystems and Components

3.1.2 DAAC-Specific Mission and Operations Activities

ECS subsystems provide mission and operations functionality for Release A. Key ECS related mission and operations activities supported by the LaRC ECS DAAC include:

TRMM CERES data ingest, production, archive and distribution

AM-1 MISR, and MOPITT science software integration and test

CERES science software updates integration and test

AM-1 interface test support

V0 data migration, archive and distribution

Transition to Release B baseline

V0 Interoperability

The objectives of Release A are to provide ECS components to support the TRMM mission; Version 0 Data Migration; EOS-AM-1 Interface Testing; and EOS-AM-1 Science Software Integration and Test. The objectives are met through deliveries of capabilities to four DAAC sites: Langley Research Center (LaRC), Marshall Space Flight Center (MSFC), Goddard Space Flight Center (GSFC) and EROS Data Center (EDC).

SDPS TRMM mission support at the LaRC ECS DAAC includes the CERES science software integration and testing of their Version 1 and Version 2 science software, the ingesting of the TRMM CERES Level 0 data, the ingesting of ancillary data for the TRMM CERES data processing, the TRMM CERES data processing, the scientific quality assurance performed by the CERES science team and the CERES data management team, and the distribution of the CERES data to the science community. Additionally, the LaRC ECS DAAC must support the MISR and MOPITT science software integration and testing of their respective beta release and Release 1.

Version 0 (V0) data migration includes the ability to transition V0 data sets from V0 to V1; and provide support, data management, search, and access capabilities for these data sets. A select LaRC V0 data sets from ERBE, ISCCP, and SAGE II will be available at Release A. Additional data migration takes place during Release A operations.

Science Software Integration and Test includes support to integrate CERES science software into the LaRC ECS DAAC. SDPS components to support Science Software Integration and Test are provided by the Data Processing and Ingest Subsystems. Ingest hardware and software components provide the capabilities to support the interface for Science Software Package delivery. Data Processing hardware and software components provide the capabilities to validate the science software operates in the LaRC ECS DAAC environment including standards checking, integration with the SDP Toolkit, and execution on the LaRC ECS DAAC processing resources.

In addition to automated support, ECS subsystems provide the capability for the ECS operations staff to perform a number of roles in support of these activities. These operational roles are identified in Table 3.1.2-1. The table identifies the corresponding SDPS or CSMS subsystem that enables the DAAC ECS operations staff to perform a particular role/function. Detailed descriptions of these activities are captured in the ECS Operations Concept for the ECS Project: Part 2A - ECS Release A (604-CD-003-001) document.

Table 3.1.2-1. LaRC Operations Support Functions (1 of 2)

ECS DAAC Operational Roles	Capability
User Services - Support user with data expertise - Generate and maintain data interface	Data Management Subsystem
Data Ingest - Monitor electronic - Handle media	Ingest Subsystem
Production Planning	Planning Subsystem
Resource Planning	Planning Subsystem Systems Management Subsystem
Production Monitoring and control	Processing Subsystem
Archive Management	Data Server Subsystem
Data Distribution - Monitor electronic - Handle media	Data Server Subsystem

Table 3.1.2-1. LaRC Operations Support Functions (2 of 2)

ECS DAAC Operational Roles	Capability
Resource Management	Processing, Ingest, Distribution & Data Server Subsystems in coordination with Systems Management Subsystem
Science software Integration Support	Processing Subsystem (1)
Database Maintenance	Data Management Subsystem Data Server Subsystem Application specific (2)
System and Performance Analysis	Systems Management Subsystem
Security	Systems Management Subsystem
Accounting and Billing	Systems Management Subsystem (3)
Sustaining Engineering	Office Support Systems Management Subsystem Communication Subsystem
S/W and H/W Maintenance	Office Support Systems Management Subsystem Communication Subsystem
Configuration Management (chg control)	Systems Management Subsystem
Testing, training, property management, integrated logistics support, library administration	Office Support Systems Management Subsystem Communication Subsystem

Notes:

1. Capability used to support CERES, MISR, and MOPITT science software integration and testing for AM-1 readiness.

2. Included to ensure that the number of small DBMSs throughout the system are not explicitly excluded (e.g., Planning Subsystem has a DBMS)

3. Not part of Release A.

3.2 LaRC External Interfaces

The LaRC ECS DAAC will interface with multiple entities external to the DAAC. The ECS subsystem-specific DID305 design documents address the interfaces generically in a series of tables supported by textual explanations. For details, the reader is referred to those documents in addition to the various Interface Control Documents (ICDs). Figure 3.2-1 schematically illustrates the interfaces between the ECS subsystems at the LaRC DAAC and its external entities (sinks and sources of data). The figure enumerates data flows which are elaborated upon in Table 3.2-1.

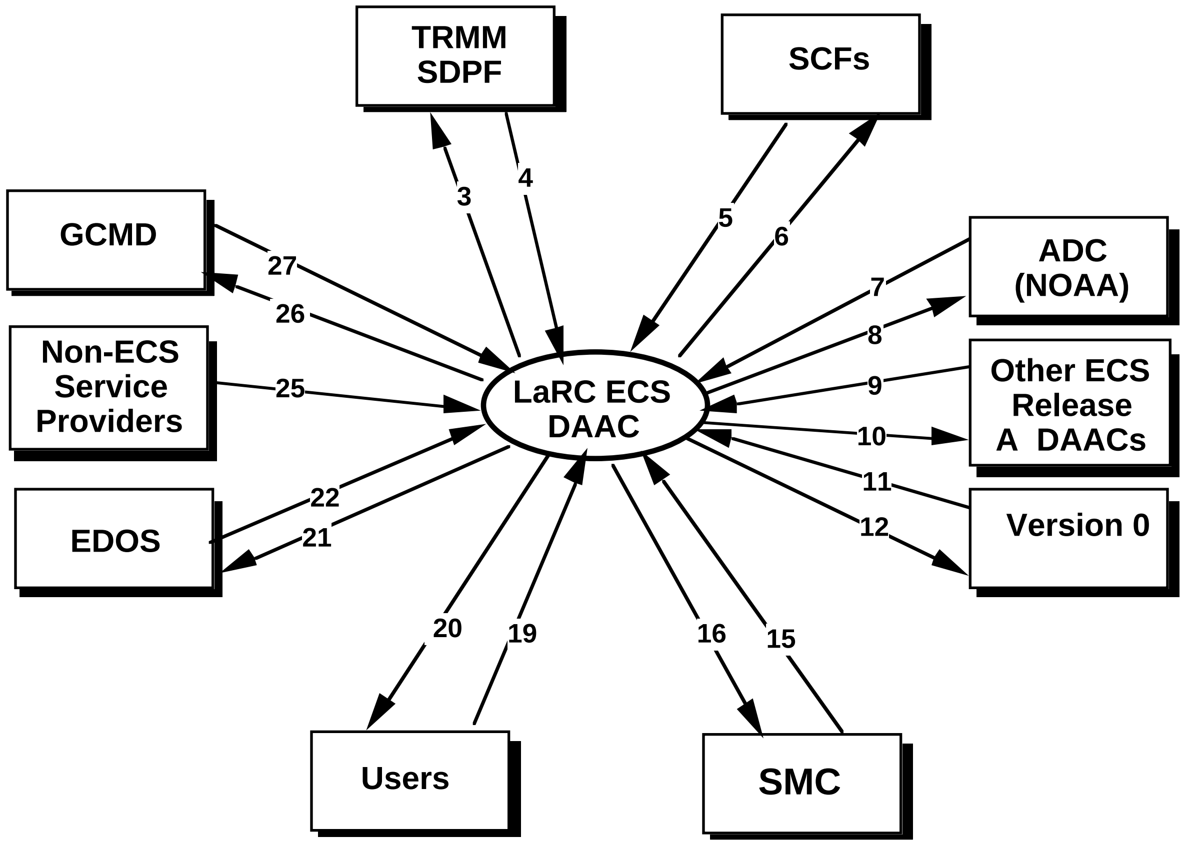

Figure 3.2-1. LaRC ECS DAAC External Interfaces

A description of the external entities follows:

- SDPF - This interface supports the transmission of the Level 0 CERES data, metadata, predictive orbit, definitive orbit, back up data and expedited data. It is almost a real time interface as there will be little delay between receipt at the SDPF and re-transmission to the LaRC ECS DAAC. Further details on this interface can be found in the TRMM SDPF Consumers ICD.
- CERES SCF–This interface is required for the CERES science software integration and testing of the Version 1 and Version 2 science software. It is also required for the scientific quality assurance during TRMM CERES data processing. CERES science software, metadata, status, quality control products, standard products, calibration data, correlative data, science software updates and documentation will traverse this interface. The CERES scientific quality assurance resides at both LaRC and non-LaRC sites.

- MISR SCF–This interface is required for the MISR science software integration and testing of the beta and Version 1 science software. MISR science software and SSI&T products will traverse this interface. This SCF is located at JPL.
- MOPITT SCF–This interface is required for the MOPITT science software integration and testing of the beta and Version 1 science software. MOPITT science software and SSI&T products will traverse this interface. This SCF is located at NCAR and University of Toronto.
- ADC (NOAA)–This interface supports access to non-EOS data sets, which are stored at the NOAA ADC, to satisfy ECS user queries. ECS will interact with NOAA NESDIS and NMC. This interface is also required to support the ancillary data requirements for the TRMM CERES data processing. The TRMM CERES primary ancillary data sets that are acquired via this interface include the following: aerosol, snow cover, and vegetation indices from NOAA/NESDIS/SAA and surface vegetation and digital elevation maps from NOAA/NESDIS/NGDC. A more detailed description of the CERES ancillary requirements is found in the CERES Data Management System Data Products Catalog (release 1, version 1, August 1994) and the CERES Data Management System Interface Requirements Document (Version 0, September 1994). This interface will also support the CERES, MISR, and MOPITT science software integration and testing of science software releases in the Release A time frame. Further details are provided in the ICD Between ECS and NOAA ADC.
- Other Release A DAACs - The interfaces to the GSFC and MSFC ECS DAACs are required to support the primary ancillary data requirements of the TRMM CERES data processing. For example, access to the GSFC DAAC will satisfy the following CERES primary ancillary data sets: TOMS column ozone, gridded products (originally from NOAA NMC), and VIRS data. And access to the MSFC DAAC will satisfy the TMI (water path) required as a CERES primary ancillary data set. Also, all Release A data products that are migrated from their respective V0 DAACs will be available to the users. Guide, inventory, standard products and other related information, identified in Table 3-1, will flow across this interface. After these interfaces are capable of supporting the TRMM CERES processing, these interfaces will also support the CERES, MISR, and MOPITT science software integration and testing.
- Version 0 – This interface is required to support the primary ancillary data requirements of the TRMM CERES data processing. The TRMM CERES primary ancillary data sets that are archived at the LaRC V0 DAAC include SAGE II and the ISCCP D1, D2, or DX products. These data sets are currently provided operationally to the LaRC V0 DAAC from the SAGE II Project and NASA Goddard Institute for Space Studies, respectively. The migration of Version 0 datasets from the LaRC V0 DAAC to the LaRC ECS DAAC will occur via this interface. Selected LaRC V0 data sets have been identified for initial inclusion into Release A: ERBE S-4, S-4G, S-4GN, S-8, S-9, and S-10N; ISCCP DX, D1, and D2; and SAGE II Level 2 & 3 products (aerosol profile, ozone profile, water vapor profile, nitrogen dioxide profile, cloud occurence, and monthly averaged ozone mixing ratio). See the LaRC DAAC Data Migration Plan for details. These data sets will be among the first maintained within the ECS Data Server paradigm, as described in

Section 3.3. This interface will also support the CERES, MISR, and MOPITT science software integration and testing of deliveries in the Release A time frame. This interface to LaRC ECS DAAC supports access, using the Version 0 System IMS, to the V0 holdings that have not currently migrated to ECS. This interface is also used to support the interoperability interface to provide cross-DAAC access.

- SMC - This interface provides the capability for the LaRC ECS DAAC to receive performance information, processing status, scheduling, and policy data and user registration information. Policy data includes that established by the ESDIS project. The LaRC ECS DAAC sends it system performance and status reports to SMC as part of this interface.
- Users – This interface is the mechanism for user community access to ECS data and services. It is the mechanism by which advertisements, user registration, order and product status, desktop object manipulations, and command languages capabilities are utilized.
- FDF–This interface with LaRC is required for AM-1 interface testing and will provide AM-1 satellite refined orbit/attitude data. This data is required for the processing of the EOS-AM1 CERES data processing.
- EDOS–At Release A, this interface is required for EOS AM-1 interface testing because the data handling function for the EOS Ground Segment is allocated to the EDOS. The science data stream down linked from the EOS AM-1 instruments is routed from EDOS to ECS after Level 0 processing. Further information is available from the EDOS ICD.
- Non-ECS Service Providers - This interface is required for specialized users who use ECS data to provide and advertise value-added services. These providers include commercial, institution, or other government agencies, as well as IPs, SCFs, and ADCs. (Not Release A)
- GCMD - The Global Change Master Directory (GSMD) is a multidisciplinary database of information about data holdings of potential interest to the scientific research community. It contains high level descriptions of data set holdings of various agencies and institutions. It also contains supplemenaty descriptions about these data centers, as well as scientific campaigns and projects, sources (spacecraft, platforms), and sensors. This interface will allow the LaRC ECS DAAC to import directory level information from the GCMD via GCMD export files and generate ECS data product advertisements.

Table 3.2-1. LaRC External Interfaces (1 of 5)

Flow No.	Source	Destination	Data Types	Data Volume	Frequency
1-2	not used				
3	Ingest	SDPF	L0 data	medium	as requested by Processing for L0 reprocessing
4	SDPF	Ingest	L0 Data	87 MB/day	daily
4	SDPF	Ingest	Validated Data	medium	three times a day
4	SDPF	Ingest	Predictive Orbit Data	medium	daily
4	SDPF	Ingest	Definitive Orbit Data	medium	daily
4	SDPF	Ingest	Back-up Data	medium	as required
5	SCF	Ingest	Algorithms/Updates	medium	as required
5	SCF	CSS (email)	Request for Resource Usage	low	as required
5	SCF	CSS (email)	Reprocessing Request	low	as required
5	SCF	Data Server	QA Data request	low	as required
5	SCF	Data Server	QA Data Subscription	low	as required
6	CSS (ftp or kftp, or email)	SCF	ECS software, documents, SSI&T status , Resource Usage	low	as required
6	Data Server	SCF	Standard Products	medium	daily as required for QA
7	ADC (NESDIS SAA)	Ingest	Metadata	low	frequency dependent on user input
7	ADC (NESDIS SAA)	Ingest	Calibration Data, Correlative Data, Documents	low	frequency dependent on user input
7	ADC (NESDIS SAA)	Data Management (V0 Gateway)	User Authentication Requests	low	as required
7	ADC (NESDIS SAA)	Client (Release A Client)	Guide Query Results	low	as required
7	ADC (NESDIS SAA)	Client (Release A Client)	Inventory Query Results	low	as required
7	ADC (NESDIS SAA)	Client (Release A Client)	Browse Results	medium	as required
7	ADC (NESDIS SAA)	Client (Release A Client)	Product Delivery Status	low	as required
7	ADC (NESDIS SAA)	ingest	Ancillary Data: Data Sets	medium (41 to 78 Mb/day) (TBR)	frequency dependent on data set
7	ADC (NESDIS SAA)	CSS	Network Management Information	N/A	as required

Table 3.2-1. LaRC External Interfaces (2 of 5)

Flow No.	Source	Destination	Data Types	Data Volume	Frequency
8	Data Managment (V0 Gateway)	ADC (NESDIS SAA)	User Authentication Results	low	as required
8	Client (Release A Client)	ADC (NESDIS SAA)	Guide Queries	low	as required
8	Client (Release A Client)	ADC (NESDIS SAA)	Inventory Queries	low	as required
8	Client (Release A Client)	ADC (NESDIS SAA)	Browse Requests	low	as required
8	Client (Release A Client)	ADC (NESDIS SAA)	Product Requests	low	frequency dependent on user input
8	Client (Release A Client)	ADC (NESDIS SAA)	Product Delivery Status Requests	low	as required
8	CSS	ADC (NESDIS SAA)	Network Management Information	N/A	as required
9	Other ECS Rel A DAACs	Ingest	Ancillary Data	high	as required
9	Other ECS Rel A DAACs	Ingest	Correlative Data	high	as required
9	Other ECS Rel A DAACs	Ingest	Calibration Data	medium	as required
9	Other ECS Rel A DAACs	Ingest	QA Data	medium	as required
9	Other ECS Rel A DAACs	Interoperability	Advertisements	medium	as required
9	Other ECS Rel A DAACs	Data Server	Result Sets	medium	as required
9	Other ECS Rel A DAACs	Client	Product Requests	medium	as required
10	Data Server	Other ECS Rel A DAACs	Standard Products	high	as required
10	Data Server	Other ECS Rel A DAACs	Metadata	medium-high	as required
10	Data Server	Other ECS Rel A DAACs	Ancillary Data	high	as required

Table 3.2-1. LaRC External Interfaces (3 of 5)

Flow No.	Source	Destination	Data Types	Data Volume	Frequency
10	Data Server	Other ECS Rel A DAACs	Correlative Data	high	as required
10	Data Server	Other ECS Rel A DAACs	Calibration Data	high	as required
10	Data Server	Other ECS Rel A DAACs	Documents	medium	as required
10	Data Server	Other ECS Rel A DAACs	Orbit/Attitude Data	medium	as required
10	Data Server	Other ECS Rel A DAACs	Data Availability Schedules	medium	as required
10	Data Server	Other ECS Rel A DAACs	Algorithms	high	as required
10	Data Server	Other ECS Rel A DAACs	L0 Data	high	as required
10	Data Server	Other ECS Rel A DAACs	Validated Data	medium	as required
10	Data Server	Other ECS Rel A DAACs	QA Data	medium	as required
10	Interoperabil-ity	Other ECS Rel A DAACs	Advertisements	medium	as required
10	Client	Other ECS Rel A DAACs	Product Requests	medium	as required
10	Data Mgmt	Other ECS Rel A DAACs	Data Dictionary	medium	as required
11	Version 0	Data Server	Inventory	low	as required
11	Version 0	Data Server	Guide	low	as required
11	Version 0	Data Server	Browse data	medium	as required
11	Version 0	Data Server	Dependent Valids	low	as required
11	Version 0 (client)	Data Mgmt (V0 Gateway)	V0 Directory search request	low	as requested
11	Version 0 (client)	Data Mgmt (V0 Gateway)	V0 Inventory search request	low	as requested
11	Version 0 (client)	Data Mgmt (V0 Gateway)	V0 browse request	low	as requested
11	Version 0 (client)	Data Mgmt (V0 Gateway)	V0 product order request	low	frequency dependent on user input
11	Version 0	Ingest	Migration Data	high	varies depending on migration strategy
12	Data Mgmt (V0 Gateway)	Version 0 (client)	V0 inventory result set	low-high	in response to ECS inventory result request

Table 3.2-1. LaRC External Interfaces (4 of 5)

Flow No.	Source	Destination	Data Types	Data Volume	Frequency
12	Data Mgmt (V0 Gateway)	Version 0 (client)	V0 directory search result set	low	in response to request
12	Data Mgmt (V0 Gateway)	Version 0 (client)	V0 Browse Result	low-medium	in response to ECS browse result
12	Data Mgmt (V0 Gateway)	Version 0 (client)	V0 product order response	low	in response to ECS product request resposne
13-14	not used				
15	SMC	MSS	Policies	low	as required
15	SMC	MSS	Procedures	low	as required
15	SMC	MSS	Directives	low	as required
16	MSS	SMC	Status	low	as required
16	MSS	SMC	Performance	low	as required
17-18	not used				
19	Users	Client	User registration information	low	as requested
19	Users	Client	User login information	low	as requested
19	Users	Client	Search requests	low	as requested
19	Users	Client	Product requests	low	as requested
19	Users	Client	Desktop manipulate commands	low	as supplied by user
19	Users	Client	Configuration/Profile information	low	as supplied by user
19	Users	Client	Command language request	low	as requested
19	Users	Client	Advertisements, Software, and Documents	low	as supplied by user
19	Users	Ingest	Ingest Status Requests	low	as required
20	Data Server	Users	Metadata	low	as requested
20	Data Server	Users	Documents	low	as requested
20	Data Server	Users	Data Products	medium	as requested
20	Data Server	Users	Browse Products	medium	as required
20	Data Server	Users	Product Request Status	low	as requested
20	Data Server	Users	Schedules	low	as requested
20	Client	Users	Results Set	medium	as requested
20	Client	Users	Application user interfaces	low	as requested

Table 3.2-1. LaRC External Interfaces (5 of 5)

Flow No.	Source	Destination	Data Types	Data Volume	Frequency
20	Client	Users	Formatted data	medium	as requested
20	Client	Users	Desktop Objects	low	as requested
20	Client	Users	Advertisement and Software	low	as requested
20	Client	Users	Error and Status information	low	as available
20	Ingest	Users	Ingest Status	low	as requested
21	Ingest	EDOS	Fault Report	low	rare
21	Ingest	EDOS	Fault Isolation Request	low	depends on EDOS
21	Ingest	EDOS	L0 data	high	rare
22	EDOS	Ingest	Service Request Disposition	low	as required
22	EDOS	Ingest	PDSs (L0 Data)	high	several times a day
22	EDOS	Ingest	PDS Delivery Record	low	several times a day
22	EDOS	Ingest	Undetected Fault Isolation	low	as required
23-24	not used				
25	Non-ECS Service Providers	Interoperability	Advertisements	low-medium	as required
25	Non-ECS Service Providers	Interoperability	Subscriptions	low	as required
26	Interoperabil -ity	Non-ECS Service Providers	Notifications	low	in response to subscriptions
27	GCMD	Interoperability	Advertisements	low-medium	as required

In the table, where an exact number is unavailable, the data volume is estimated as low (less than 1 MB), medium (between 1 MB and 1 GB), or high (greater than 1 GB) per use defined in the frequency column . The frequency information will be updated as the interfaces are fully defined. Note that EDOS interface is implemented only to the extent needed for purposes of early interface testing at Release A.

3.3 Computer Software Component Analysis

The ECS software subsystems are described in detail in the ECS Subsystem-specific DID 305 documents. This section provides a brief overview description of each of the subsystems, then as part of the analysis, addresses the CSCIs for each subsystem, focusing upon those CSCIs that are specific to the LaRC ECS DAAC. For the most part, the software is the same for GSFC, LaRC, and MSFC ECS DAACs. However, the content of databases and schema constructions may differ. In addition, the purchase of different OTS packages for the DAACs may be required.

3.3.1 Software Subsystem Overview

The 10 ECS software subsystems are described in detail in the ECS Subsystem-specific DID305 documents. This section provides a brief overview description of each of the subsytems.

Client Subsystem (CLS): This software consists of graphic user interface (GUI) programs, tools for viewing and/or manipulating the various kinds of ECS data (e.g., images, documents, tables) and libraries representing the client application program interface (API) of ECS services. For Release A, the client subsystem will consist of the desktop, an advertising user interface, and a data visualization tool (EOSView). The remainder of the Release A user interface will be provided by an enhanced version of the V0 System Client. The client subsystem components will available to users for installation on their workstations and will also be deployed on workstations within the DAAC in support of normal operations, including User Services support.

Interoperability Subsystem (IOS): The SDPS is designed as a collection of distributed applications. They are supported by distributed operating system and communications services. They are part of the CSMS and are described in the CSS Design Specification [305-CD-012-001]. To these functions, the SDPS interoperability subsystem adds an advertising service. It maintains a database of information about the services and data offered by ECS, and allows users to search through this database to locate services and data that may be of interest to them. The advertising service will be implemented as an SDPS developed distributed database application on top of a commercial off-the-shelf Data Base Management System (DBMS).

Data Management Subsystem (DMS): This subsystem includes functions which provide uniform access to descriptions of the data and the data elements offered by the EOSDIS repositories and provide a bidirectional gateway between ECS and Version 0. This subsystem also includes distributed search and retrieval functions and corresponding site interfaces, however, they are not part of the Release A design.

Data Server Subsystem (DSS): The subsystem provides the physical storage access and management functions for the ECS earth science data repositories. Other subsystems can access it directly or via the data management subsystem (if they need assistance with searches across several of these repositories). The subsystem also includes the capabilities needed to distribute bulk data via electronic file transfer or physical media. Other components include, for example, administrative software to manage the subsystem resources and perform data administration functions (e.g., to maintain the database schema); and data distribution software, e.g., for media handling and format conversions.The main components of the subsystem are the following:

- database management system - SDPS will use an off-the-shelf DBMS (SYBASE) to manage its earth science data and implement spatial searching, as well as for the more traditional types of data (e.g., system administrative and operational data). It will use a document management system to provide storage and information retrieval for guide documents, scientific articles, and other types of document data.

- file storage management systems - they are used to provide archival and staging storage for large volumes of data. SDPS is considering the use of several hardware/software configurations which are either off-the-shelf or a mixture of off-the-shelf and developed software.
- data type libraries - they will implement functionality of earth science and related data that is unique and not available off the shelf (e.g., spatial search algorithms and translations among coordinate systems). The libraries will interface with the data storage facilities, i.e., the database and file storage management systems.

Ingest Subsystem (INS): The subsystem deals with the initial reception of all data received at an EOSDIS facility and triggers subsequent archiving and processing of the data. Given the variety of possible data formats and structures, each external interface, and each ad-hoc ingest task may have unique aspects. Therefore, the ingest subsystem is organized into a collection of software components (e.g., ingest management software, translation tools, media handling software) from which those required in a specific situation can be readily configured. The resultant configuration is called an ingest client. Ingest clients can operate on a continuous basis to serve a routine external interface; or they may exist only for the duration of a specific ad-hoc ingest task.

Data Processing Subsystem (DPS): The main components of the data processing subsystem - the science software - will be provided by the science teams. The data processing subsystem will provide the necessary hardware resources, as well as software for queuing, dispatching and managing the execution of the science software in an environment which eventually will be highly distributed and consist of heterogeneous computing platforms. The DPS also interacts with the DSS to cause the staging and de-staging of data resources in synchronization with processing requirements.

Planning Subsystem (PLS): This subsystem provides the functions needed to pre-plan routine data processing, schedule ad-hoc processing, and dispatch and manage processing requests. The subsystem provides access to the data production schedules at each site, and provides management functions for handling deviations from the schedule to operations and science users.

System Management Subsystem (MSS): The Management Subsystem (MSS) provides enterprise management (network and system management) for all ECS resources: commercial hardware (including computers, peripherals, and network routing devices), commercial software, and custom applications. Enterprise management reduces overall development and equipment costs, improves operational robustness, and promotes compatibility with evolving industry and government standards. Consistent with current trends in industry, the MSS thus manages both ECS's network resources per ESN requirements and ECS's host/application resources per SMC requirements. Additionally MSS also supports many requirements allocated to SDPS and FOS for management data collection and analysis/distribution.

The MSS allocates services to both the system-wide and local levels. With few exceptions, the management services will be fully decentralized, no single point of failure exists which would preclude user access. In principle every service is distributed unless there is an overriding reason for it to be centralized. MSS has two key specializations: Enterprise Monitor and Coordination Services and Local System Management Services.

For IR-1 and Release A not all of the MSS services will be fully implemented, some will be provided through COTS and COTS customization, while others will be provided through the use of Office Automation (OA) tools.

Communications Subsystem (CSS): The CSS services include Object Services, Distributed Object Framework (DOF) and Common Facility Services. Support in this subsystem area is provided for peer-to-peer, advanced distributed, messaging, management, and event-handling communications facilities. These services typically appear on communicating end-systems across an internetwork and are not layered, but hierarchical in nature. Additionally, services to support communicating entities are provided, included directory, security, time, and other ancillary services. The services of the Communications Subsystem are functionally dependent on the services of the Internetworking Subsystem. The services of the common facility, object and DOF are the fundamental set of interfaces for all CSMS management and FOS and SDPS user access (i.e., pull) domain services. The DOF services are the fundamental set of dependencies of the common facility and object services.

Internetworking Subsystem (ISS): The Internetworking Subsystem provides for the transfer of data transparently within the DAACs, SMC and EOC, and for providing interfaces between these components and external networks. ECS interfaces with external systems and DAAC to DAAC communications are provided by the EOSDIS Backbone Network (EBnet). EBnet’s primary function is to transfer data between DAACs, including both product data and inter-DAAC queries and metadata responses. Other networks, such as NSI, will provide wide-area services to ECS. In addition, "Campus" networks, which form the existing networking infrastructure at the ECS locations, will provide connectivity to EOSDIS components such as SCFs and ISTs.

3.3.2 Software Subsystem Analysis Summary

The subsystems that comprise SDPS and CSMS have already been described in detail in companion CDR documents. This section addresses the CSCIs from each subsystem and identifies their LaRC ECS DAAC specifics. Generally, the software is the same for GSFC, LaRC, and MSFC ECS DAACs. The content of databases and schema constructions may differ. In the case of OTS packages the possibility arises for the purchase of different versions for different DAAC hardware but even this will be extremely minimal for Release A. In this section, each of the subsystems will be addressed in a somewhat general manner to point out whether or not there are any LaRC DAAC specific portions.

- Client Subsystem - The client software will not have any LaRC ECS DAAC specific portions except for the possibility of different versions of OTS packages due to different types of hardware. Since the services offered by the client are required by operations, user services, and systems administrators, the LaRC ECS DAAC will have clients installed on several different ECS furnished workstations. In addition the LaRC V0 DAAC may desire the client on some of their existing workstations to provide additional user access·

- Data Server - This subsystem will have certain portions that may be specific to the LaRC ECS DAAC due to the LaRC ECS DAAC data collections. Each data collection is mapped to a logical data server. A logical data server implies that for each of the collections there will be a window into the LaRC ECS DAAC that is associated with that collection of data. Each data collection will be managed by its own logical data server. The logical data servers will be mapped to physical data servers (i.e. hardware) using sizing projections from modeling efforts currently underway. Several physical data servers will be mapped to a given configuration of processing and archive resources.

  The data collections were identified by number and name, as part of the PDR Taxonomy activities performed in support of the Data Modeling Working Group. The types of data services available with each data collection and the data type services software may vary. These data type services contribute to the uniqueness of the LaRC ECS DAAC. The following list identifies the Release A data collections (and, by definition, their logical data servers), with the PDR Taxonomy (March 95) identification number preceding the collection name. The logical data servers are also mapped to the physical data servers (expressed in CSC nomenclature as found in the Release A SDPS Data Server Subsystem Design Specification for the ECS Project (DID 305-CD-008-001)).

  -- (77) ERBE, CERES (ERP) : This logical data server is required to support Version 0 to Version 1 data migration. This data server is required to support the CERES science software integration and testing of the Version 1 and Version 2 science software and the TRMM CERES data processing. This logical data server maps to physical data server: (SDSRV CSCI, CERES CSC).

  -- (78) CERES (L0/1): This logical data server is required to support the CERES science software integration and testing of the Version 1 and Version 2 science software, the ingesting of the TRMM CERES Level 0 data, and the TRMM CERES data processing. This logical data server maps to physical data server: (SDSRVCSCI, CERES CSC).

  -- (87) SAGE (Atmospheric Products): This logical data server is required to support Version 0 to Version 1 data migration. This logical data server is also required to support the CERES science software integration and testing of the Version 1 and Version 2 science software and the TRMM CERES data processing. This logical data server maps to physical data server: (SDSRV CSCI, Non-Product Science ESDTs CSC).

  -- (89) ISCCP (Atmos Dyn): This logical data server is required to support Version 0 to Version 1 data migration. This logical data server is also required to support the CERES science software integration and testing of the Version 1 and Version 2 science software and the TRMM CERES data processing. This logical data server maps to physical data server: (SDSRV CSCI , Non-Product Science ESDTs CSC).

- -- (90) FIRE Land: This logical data server is required to support Version 0 to Version 1 data migration of FIRE CI1, MS, CI2, and ASTEX. This logical data server maps to physical data server: (SDSRV CSCI , Non-Product Science ESDTs CSC).
- -- (92) IDS (ERP) : This logical data server may be required to support the TRMM CERES processing. This logical data server maps to physical data server: (SDSRV CSCI , Non-Product Science ESDTs CSC).

- Data Management - None of the data management software will be unique to the LaRC ECS DAAC. The V0 Gateway (GTWAY) will interface with the data servers at each site. Local and cross-DAAC searches on V0 DAACs' data holdings are provided via capabilities resulting from integrating the components from the V0 System IMS into ECS.
- Ingest - The software portions for ingest at the LaRC ECS DAAC may differ from those of other ECS DAACs because of dataset dependencies and differences related to non-homogeneous computer hardware across the three Release A DAACS. Data ingestion procedures must match the peculiarities of the ingested data sets. Several types of ingest clients are described in the Data Server Subsystem companion document. The primary client was based on an approach used by TRMM SDPF . Since the SDPF is the source of CERES L0 data, that type of ingest client represents one of the set to be implemented for the LaRC ECS DAAC
- Interoperability - There are no LaRC ECS DAAC specific portions of the Interoperability Subsystem ·
- Production Planning - While it is expected that the actual development code and OTS packages required for the LaRC ECS DAAC will be generic, there will be a considerable amount of configuration and database information that will be specific. Scripts, while they may use the same language, will be different and will trigger different responses in response to faults and other error conditions ·
- Data Processing - Due to dataset characteristics there will be some specific software for the LaRC ECS DAAC in the area of Science Data Processing. In addition, as with the data server and ingest subsystems, differences in hardware types, driven by algorithm requirements, will also result in some differences in software·
- Communications Subsystem - There are no LaRC ECS DAAC specific portions of this subsystem.
- Systems Management - This subsystem is composed of a variety of management applications, providing services such as fault, performance, security and accountability management for ECS networks, hosts, and applications. Two tiers of "view" (domain of management service interface) provided by the applications in this subsystem. Only the local management view is provided at the LaRC ECS DAAC. There are no LaRC ECS DAAC specific portions of this subsystem.
- Internetworking Subsystem - There are no LaRC ECS DAAC specific portions of this subsystem.

Table 3.3.2-1 lists the ECS subsystems and associated CSCIs and CSCs. For each CSC, there is an indication of the type of component. As defined in the DID 305 subsystem-specific documents, type indicates whether the component is custom developed (DEV), off the shelf (OTS), a CSC reused from another subsystem (reuse), a wrapper (WRP) that encapsulates OTS, or a combination of these types. The Use column indicates whether a generic-for-all-DAACs (Gnrc) form of the CSC is implemented or specific (Spf) tailoring or use is required at a DAAC. The Notes column is included to comment about the characteristics of the system, data, and/or software that makes the CSC specific, as well as to provide any additional information about the generic CSCs. The OTS products are also listed in this column.

Table 3-3.2-1. LaRC Components Analysis (1 of 8)

Subsystem	CSCI	CSC	TYPE	USE	NOTES
Client	DESKT	Desktop	DEV	Gnrc	
Client	WKBCH	Hypertext Viewer CSC	OTS	Gnrc	Netscape
Client	WKBCH	Data Visualization (EOSView) CSC	DEV	Gnrc	
Client	WKBCH	SDPS Toolkit CSC	DEV	Gnrc	
Client	WKBCH	CSMS Toolkit CSC	DEV	Gnrc	
Client	WKBCH	Release A Client	OTS	Gnrc	enhanced V0 client
CSS	DCCI	File Access Services	OTS/ DEV	Gnrc	native operating system (ftp)
CSS	DCCI	Message Passing Services	DEV	Gnrc	Developed with OODCE
CSS	DCCI	Time Services	OTS/ DEV	Gnrc	OODCE
CSS	DCCI	Event Logger Services	DEV	Gnrc	
CSS	DCCI	Electronic Mail Services	OTS/ DEV	Gnrc	native operating system
CSS	DCCI	Thread Services	OTS	Gnrc	OODCE
CSS	DCCI	Directory/Naming Services	OTS/ DEV	Gnrc	OODCE
CSS	DCCI	Life Cycle Services	OTS/ DEV	Gnrc	OODCE
CSS	DCCI	Security Services	OTS/ DEV	Gnrc	OODCE
CSS	DCCI	DOF Services	OTS	Gnrc	OODCE
CSS	DCCI	Virtual Terminal Services	OTS	Gnrc	native operating system
Data Management	GTWAY	Gateway Server	DEV	Gnrc	
Data Management	GTWAY	V0 IMS server	OTS	Gnrc	enhanced version of V0 server

Table 3-3.2-1.   LaRC Components Analysis (2 of 8)

Subsystem	CSCI	CSC	TYPE	USE	NOTES
Data Management	GTWAY	Gateway DBMS	OTS	Gnrc	Sybase DBMS
Data Processing	AITTL	Documentation Viewing Tools	OTS	Gnrc	SoftWindows/MS Office Ghostview
Data Processing	AITTL	Standards Checkers	OTS/ DEV	Spf	FORCHECK for Fortran 77; otherwise, native compilers
Data Processing	AITTL	Code Analysis Tools	OTS	Spf	CASEVision SPARCWorks
Data Processing	AITTL	Data Visualization Tools	OTS	Gnrc	IDL
Data Processing	AITTL	ECS HDF Visualization Tools	DEV	Gnrc	CSC reused from WKBCH CSCI - EOSView
Data Processing	AITTL	HDF File Comparison Utility	DEV	Gnrc	Custom IDL program
Data Processing	AITTL	Binary File Comparison Utility	DEV	Gnrc	
Data Processing	AITTL	Profiling Tools	OTS	Spf	CASEVision
Data Processing	AITTL	PGE Processing GUI	DEV	Gnrc	
Data Processing	AITTL	PGE Registration GUI	DEV	Gnrc	
Data Processing	AITTL	Report Generation Tools	OTS/ DEV	Gnrc	OTS: SoftWindows/MS Office, DEV: AI&T manager
Data Processing	AITTL	SDP Toolkit-related Tools	DEV	Gnrc	
Data Processing	AITTL	Product Metadata Display Tool	DEV	Gnrc	reused from HDF File Comparison Utility CSC
Data Processing	PRONG	Resource Management	DEV	Gnrc	
Data Processing	PRONG	COTS	OTS	Gnrc	AutoSys and AutoXpert
Data Processing	PRONG	COTS Management	DEV	Gnrc	
Data Processing	PRONG	Data Management	DEV	Gnrc	

Table 3-3.2-1. LaRC Components Analysis (3 of 8)

Subsystem	CSCI	CSC	TYPE	USE	NOTES
Data Processing	PRONG	Data Pre-Processing	DEV	Spf	Based on uniqueness of ancillary data products
Data Processing	PRONG	PGE Execution Management	DEV	Gnrc	
Data Processing	PRONG	Quality Assurance Monitor	DEV	Spf	
Data Processing	SDPTK	Ancillary Data Access	DEV	Gnrc	
Data Processing	SDPTK	Celestial Body Position	DEV	Gnrc	
Data Processing	SDPTK	Coordinate System Conversion	DEV	Gnrc	
Data Processing	SDPTK	Constant and Unit Conversions	DEV	Gnrc	
Data Processing	SDPTK	Ephemeris Data Access	DEV	Gnrc	
Data Processing	SDPTK	Geo Coordinate Transformation	DEV	Gnrc	
Data Processing	SDPTK	Input/Output	DEV	Gnrc	
Data Processing	SDPTK	Memory Management	DEV	Gnrc	
Data Processing	SDPTK	Metadata Access	DEV	Gnrc	
Data Processing	SDPTK	Process Control	DEV	Gnrc	
Data Processing	SDPTK	Status Message File (Error/Status)	DEV	Gnrc	
Data Processing	SDPTK	Time Date Conversion	DEV	Gnrc	
Data Processing	SDPTK	Math Package	OTS	Gnrc	IMSL
Data Processing	SDPTK	Graphics Library	OTS	Gnrc	IDL
Data Processing	SDPTK	EOS-HDF	DEV	Gnrc	
Data Server	DDIST	Distribution Products	DEV	Gnrc	
Data Server	DDIST	Distribution Client Interface	DEV	Gnrc	
Data Server	DDIST	Distribution Request Management	DEV	Gnrc	
Data Server	DDSRV	DDSRV	DEV	Gnrc	

Table 3-3.2-1. LaRC Components Analysis (4 of 8)

Subsystem	CSCI	CSC	TYPE	USE	NOTES
Data Server	DDSRV	DDSRV Server	DEV	Gnrc	
Data Server	DDSRV	DDSRV Client	DEV/ OTS	Gnrc	HTTP libraries
Data Server	DDSRV	DDSRV ESDT	DEV/ OTS	Gnrc	RogueWare class libraries
Data Server	DDSRV	DDSRV CSDT	DEV/ OTS	Gnrc	RogueWare class libraries
Data Server	DDSRV	DDSRV Search Engine	OTS	Gnrc	Text Search Indexor and HTTP server
Data Server	SDSRV	Administration/ Operation	DEV	Gnrc	
Data Server	SDSRV	Client	DEV/ OTS	Gnrc	RogueWare class libraries and OODCE
Data Server	SDSRV	Configuration/Startup	DEV	Gnrc	
Data Server	SDSRV	Metadata	DEV/ WRP	Gnrc	Sybase DBMS
Data Server	SDSRV	CSDT	WRP	Gnrc	HDF-EOS
Data Server	SDSRV	DB WRPs	WRP	Gnrc	Sybase
Data Server	SDSRV	Descriptors	DEV/ OTS	Gnrc	RogueWare class libraries
Data Server	SDSRV	General ESDT	DEV	Gnrc	
Data Server	SDSRV	Global	DEV/ OTS	Gnrc	RogueWare class libraries
Data Server	SDSRV	GUI	DEV	Gnrc	
Data Server	SDSRV	Non-Product Science ESDTs	DEV	Gnrc	
Data Server	SDSRV	Non-Science ESDTs	DEV	Gnrc	
Data Server	SDSRV	Server	DEV/ OTS	Gnrc	RogueWare class libraries
Data Server	SDSRV	Subscriptions	DEV/ OTS	Gnrc	RogueWare class libraries
Data Server	SDSRV	CERES	DEV	Spf	
Data Server	STMGT	Service Clients	DEV/ OTS	Gnrc	CSC encapsulates the AMASS File Storage Management System OTS product . Also RogueWare class libraries.

Table 3-3.2-1. LaRC Components Analysis (5 of 8)

Subsystem	CSCI	CSC	TYPE	USE	NOTES
Data Server	STMGT	Resource Management	DEV	Gnrc	
Data Server	STMGT	Data Storage	DEV/ OTS	Gnrc	AMASS File Storage Management System
Data Server	STMGT	Peripherals	DEV	Gnrc	This CSC encapsulates the CSS supplied API which supports the OTS FTP product.
Data Server	STMGT	File	DEV	Gnrc	
Ingest	INGST	Ingest Session Manager	DEV	Gnrc	
Ingest	INGST	Polling Ingest Client Interface	DEV	Gnrc	
Ingest	INGST	Ingest Request Processing	DEV	Gnrc	
Ingest	INGST	Ingest Data Transfer	DEV	Gnrc	
Ingest	INGST	Operator Ingest Interface	DEV	Gnrc	
Ingest	INGST	User Network Ingest Interface	DEV	Gnrc	
Ingest	INGST	Ingest DBMS	OTS	Gnrc	Sybase DBMS
Ingest	INGST	Ingest Administration Data	DEV	Gnrc	
Ingest	INGST	Peripheral Software	Reuse	Gnrc	CSC reused from DDIST CSCI
Ingest	INGST	Viewing Tools	Reuse	Gnrc	CSC reused from WKBCH CSCI - EOSView
Ingest	INGST	Client Services	Reuse	Gnrc	
Ingest	INGST	Ingest Data Preprocessing	DEV	Spf	
Ingest	INGST	Data Storage Software	Reuse	Gnrc	CSC reused from SDSRV CSCI and STMGT CSCI NOTE: Used for L0 storage
Ingest	INGST	Resource Administration	Reuse	Gnrc	CSC reused from SDSRV CSCI and STMGT CSCI
Interoperability	ADSRV	AdvApplDBMSServer	DEV	Gnrc	
Interoperability	ADSRV	AdvDBMSServer	OTS	Gnrc	Sybase DBMS

Table 3-3.2-1. LaRC Components Analysis (6 of 8)

Subsystem	CSCI	CSC	TYPE	USE	NOTES
Interoperability	ADSRV	AdvTextServer	OTS	Gnrc	reuse of data server subsystem, DDSRV CSCI , Search engine CSC text search indexor
Interoperability	ADSRV	AdvNavigatingServer	OTS	Gnrc	reuse of data server subsystem, DDSRV CSCI , Search engine CSC HTTP server
Interoperability	ADSRV	GCMD Exporter	DEV	Gnrc	
ISS	INCI	Datalink/Physical	OTS	Gnrc	firmware, vendor-supplied with hardware
MSS	MCI	Management Framework	OTS/ DEV	Gnrc	HP OpenView Network Node Manager
MSS	MCI	Diagnostic Tests	OTS	Gnrc	vendor-supplied with hardware
MSS	MCI	Application Management	DEV	Gnrc	
MSS	MCI	Automatic Actions	DEV	Gnrc	
MSS	MCI	Resource Class Category	DEV	Gnrc	
MSS	MCI	Performance Manager	OTS/ DEV	Gnrc	not chosen yet
MSS	MCI	Report Generation and Distribution	DEV	Gnrc	
MSS	MCI	Performance Test	OTS	Gnrc	vendor-supplied with hardware
MSS	MCI	Performance Management Proxy	DEV	Gnrc	
MSS	MCI	Security Manager	DEV	Gnrc	
MSS	MCI	Security Databases	OTS	Gnrc	Operating System Password Files, DCE Registry Database, Router Configuration Files, TCP Wrappers configuration files, Operating System Access Control Lists, DCE Access Control Lists

Table 3-3.2-1. LaRC Components Analysis (7 of 8)

Subsystem	CSCI	CSC	TYPE	USE	NOTES
MSS	MCI	Tests	OTS	Gnrc	CRACK, COPS, SATAN, TRIPWIRE
MSS	MCI	DCE Cell Management	OTS	Gnrc	HAL DCE Cell Manager
MSS	MCI	Security Management Proxy	DEV	Gnrc	
MSS	MCI	Accountability Manager	DEV	Gnrc	
MSS	MCI	User Profile Server	DEV	Gnrc	
MSS	MCI	Management Proxy	DEV	Gnrc	
MSS	MCI	Physical Configuration Manager	OTS	Gnrc	Mountain View
MSS	MCI	Network Manager	OTS	Gnrc	HP OpenView Network Node Manager
MSS	MCI	Physical Configuration Proxy Agent	DEV	Gnrc	
MSS	MCI	Trouble Ticketing Management Services	OTS	Gnrc	Remedy Action Request System
MSS	MCI	Trouble Ticketing User Interface	DEV	Gnrc	
MSS	MCI	Trouble Ticketing Service Requester	DEV	Gnrc	
MSS	MCI	Trouble Ticketing Proxy Agent	DEV	Gnrc	
MSS	MCI	Management Data Access Services	DEV	Gnrc	
MSS	MCI	Management Data Access User Interface	DEV	Gnrc	
MSS	MCI	Ground Events Planning	reuse	Gnrc	reused from Planning Subsystem, PLANG CSCI ,planning workbench CSC
MSS	MLCI	Baseline Manager	OTS/ DEV	Gnrc	Not chosen yet
MSS	MLCI	Software Change Manager	OTS/ DEV	Gnrc	ClearCase
MSS	MLCI	Change Request Manager	OTS/ DEV	Gnrc	Distributed Defect Tracking System
MSS	MACI	Extensible SNMP Master Agent	OTS/ DEV	Gnrc	Peer Network's agent, along with its toolkit for DEV
MSS	MACI	ECS Subagent	DEV	Gnrc	

Table 3-3.2-1. LaRC Components Analysis (8 of 8)

Subsystem	CSCI	CSC	TYPE	USE	NOTES
MSS	MACI	DCE Proxy Agent	DEV	Gnrc	
MSS	MACI	Encapsulator for non-Peer Agent	OTS/ DEV	Gnrc	non-Peer agents not chosen yet, thus encapsulation not chosen yet.
MSS	MACI	SNMP Manager's Deputy	DEV	Gnrc	
MSS	MACI	Instrumentation Class Library	DEV	Gnrc	
MSS	MACI	Application MIB	DEV	Gnrc	
Planning	PLANG	Production Request Editor	DEV	Gnrc	
Planning	PLANG	Subscription Editor	DEV	Gnrc	
Planning	PLANG	Subscription Manager	DEV	Gnrc	
Planning	PLANG	Planning Workbench	DEV	Gnrc	
Planning	PLANG	Planning Object Library	OTS	Gnrc	Delphi C++ class libraries
Planning	PLANG	PDPS DBMS	OTS	Gnrc	Sybase DBMS

3.4 DAAC Hardware and Network Design

This section provides an overview of the hardware configuration currently envisioned to support the Release A TRMM mission for LaRC. Included below are details with respect to the Release A LANs (within Section 3.4.1), and the SDPS and remaining CSMS hardware (within Section 3.4.2). The LAN configuration discussion provides an overview diagram, Figure 3.4.1-1, which focuses on the LaRC configuration from the "networks" point of view. The remaining hardware discussions include an overview of the processing, server, workstation and associated peripherals with an overview diagram, Figure 3.4.2-1, providing details on sizes, quantities, classes and in most cases vendor and model numbers.

Note that the recommended configurations are based on design analysis and/or prototyping analysis in progress. Some design analysis is still proceeding on the incremental development track which relies heavily on prototyping. As further prototyping and design analysis is performed, the ECS Team will continue to provide cost /performance analysis that is expected to impact the recommended configurations given in this document. Therefore, "selected" make and model numbers are still subject to change.

The following subsections provide details of the design *rationale* and recommended *configuration* for each of the CSMS and SDPS subsystems.

3.4.1 LaRC DAAC LAN Configuration

The LaRC DAAC LAN topology is illustrated in Figure 3.4.1-1. The network consists of six FDDI rings supporting the DAAC subsystems and connections to external systems. The Ingest, PDPS, and LSM subsystems are contained on individual FDDI rings, while Data Server and Data Manager have been combined onto a single ring. There are also dedicated FDDI rings for external connections to the V0 network and to the EBnet router. The FDDI switch is the central device connecting the rings together. (For a description of the generic DAAC LAN topology and the reasons behind it, refer to Section 5.2.2 of Science and Communications Development Office (SCDO): Release A Overview for the ECS Project.)

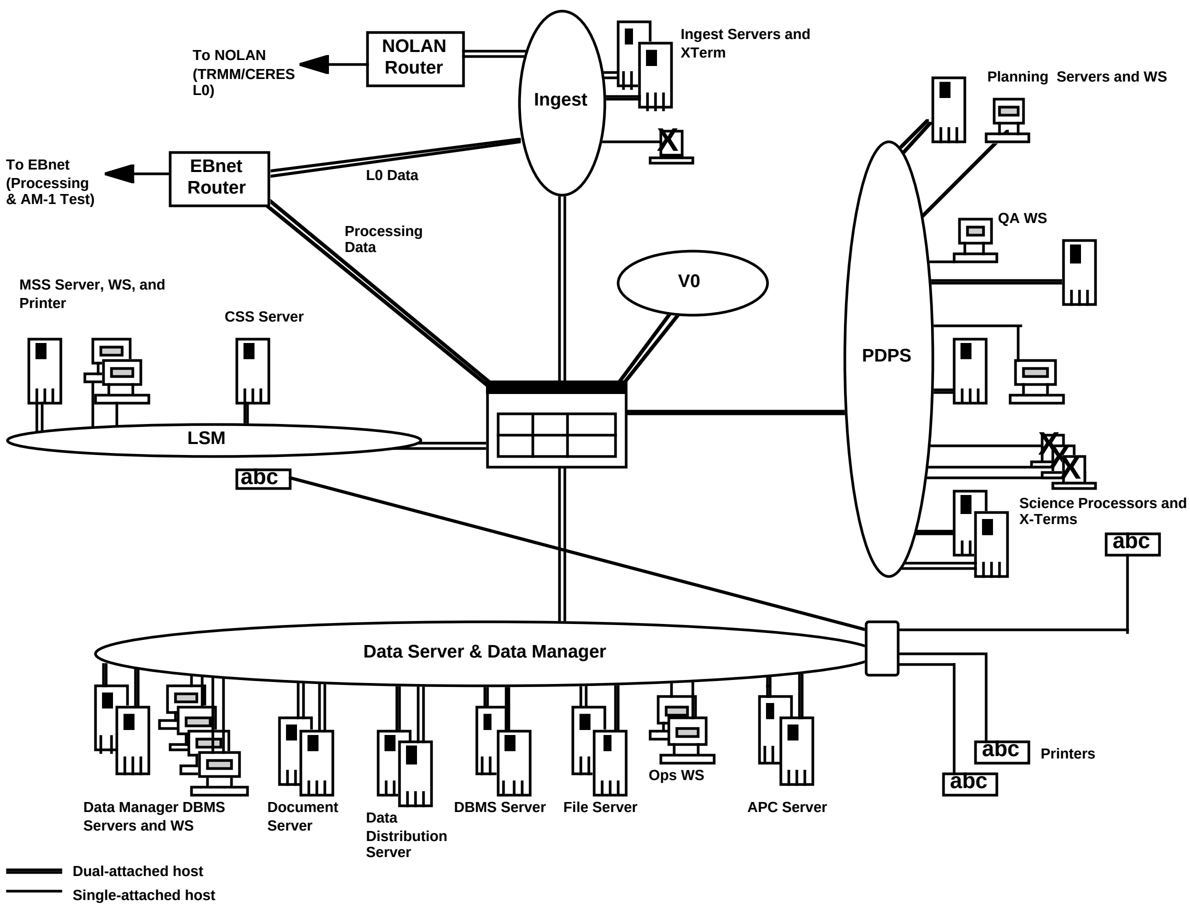

Figure 3.4.1-1. LaRC DAAC LAN Topology

The individual FDDI rings will be implemented with FDDI concentrators to provide ease of wiring and central points of management. All DAAC hosts will have FDDI interfaces and will be attached directly to the FDDI rings. Workstations will have single-attached FDDI cards, whereas the high-performance servers and processors will have dual-attached FDDI cards to provide redundancy. (Note that hosts with DAS cards are identified in Figure 3.4.1-1 by dual lines connecting to the FDDI ring.) Dual-attached hosts will be dual-homed to two separate FDDI concentrators to provide an additional level of redundancy in the event of a hub failure. Printers, which will be the only Ethernet devices in the DAAC, will be connected to the Data Server FDDI ring via an FDDI-to-Ethernet hub. (Note that the detailed network implementation on a subsystem basis is presented in Volume 1, the subsystem-specific design description.)

The LaRC DAAC will have connections to the existing V0 network, to EBnet, and to NOLAN. The V0 network will be directly connected to the FDDI switch, primarily to facilitate V0 data migration to the Data Server subsystem. Although the detailed implementation of EBnet is still in progress (see Section 5.1.1 of Science and Communications Development Office (SCDO): Release A Overview for the ECS Project.), Figure 3.4.1-1 reflects current understanding of the interface. The DAAC connection to EBnet will be via separate FDDI interfaces on a single router. One interface will connect directly to the Ingest subsystem in order to provide early interface testing of AM-1 CERES L0 data (bypassing the FDDI switch), thereby decreasing complexity of the data flow and correspondingly increasing availability. The second interface to the EBnet router will carry both DAAC-to-DAAC processing flows as well as user traffic to/from NSI. This interface will connect directly to the FDDI switch which will route data to the proper subsystem (Data Manager, Data Server, LSM, etc.). The NOLAN router will connect directly to the Ingest subsystem in order to provide direct delivery of TRMM CERES L0 data (bypassing the FDDI switch), thereby decreasing complexity of the data flow and correspondingly increasing availability.

The quantities of networking hardware components for each DAAC subsystem is presented in Table 3.4.1-1. Specific vendor information and selection rationale is presented in Section 5.3 of Science and Communications Development Office (SCDO): Release A Overview for the ECS Project.. Note that the FDDI switch vendor selection is currently under evaluation.

Table 3.4.1-1. Networking Hardware for LaRC DAAC LAN

Networking Component	DAAC Subsystem	Quantity	Comments
FDDI Concentrator	Ingest	2	Synoptics 2914-04 concentrator with 12 M ports
	Data Manager & Data Server	3	and 1 A/B Port
	PDPS	2	
	LSM	2	
FDDI Cables	Ingest	11	Multimode fiber cables with MIC connectors. Also, four additional cables (not listed) are required for connection to EBnet and VO.
	Data Manager & Data Server	33	
	PDPS	18	
	LSM	8	
FDDI-to-Ethernet Hub	N/A	1	Used only for Ethernet-based printers; connects to printers used in all subsystems
Ethernet Cables	N/A	4	10baseT connection to printers
FDDI Switch	N/A	1	Connects all subsystems together

3.4.1.1 Sizing/Performance Rationale

The data flow estimates used as input to the design process for the LaRC DAAC LAN topology are contained in Tables 3.4.1.1-1 and 3.4.1.1-2. The first table, based on both dynamic and static analysis performed by ECS, using the ECS Technical Baseline dated January 95, is arranged according to the source and sink of the flow. The second table simply aggregates these flows by subsystem to provide insight into the amount of data expected on each of the LaRC DAAC FDDI rings.

The values contained in the table include all overhead and contingency factors. The "raw" numbers provided from the model were 24 hour averages. Factors for protocol overhead (25%, or a multiplier of 1.25) and circuit utilization (1.25) were applied, as was a 1.2 factor to provide for AI&T. A factor of 1.5 was used to convert from the 24 hour averages to peaks, and a factor of 1.2 was used in order to allow the network to "catch up" within 24 hours after a 4 hour down period (derived from 24/20 = 1.2). In addition, an operational availability factor was used for each of the DAACs to account for processing being performed only during staffed hours. This factor was 1.5 at LaRC (since it will be 16X7). Note that this factor is applied only to processing flows.

Table 3.4.1.1-1. Estimated Release A Data Flows for the LaRC DAAC

Flow Description	Data Flow Volume (in Mbps)
L0 Ingest to Data Server	0.126
V0 Ingest to Data Server	2.042
Data Server to Processing	17.650
Data Server to Distribution Server	13.126
Processing to Distribution	8.250
Data Server to/from other DAACs	0.872
Data Server/Data Manager to Users	0.399
LSM to other Subsystems	0.05

Table 3.4.1.1-2. Estimated Release A Data Flows per DAAC LAN FDDI Ring for LaRC

DAAC Subsystem FDDI Ring	Data Flow Volume (in Mbps)
Ingest	0.252
Planning and Data Processing	25.900
Data Manager and Data Server	42.465
Interface to EBnet Router (For DAAC-DAAC and User Flows)	1.271
LSM	0.05

3.4.2 LaRC Hardware Configuration

The LaRC hardware configuration builds on the Ir1 supplied capacity and is designed explicitly to support TRMM Mission operations. Sizing at LaRC is based on the ECS CDR Technical Baseline and is sized for one calendar year of TRMM operations beyond launch.

The subsections which follow below provide a synopsis of the design process, and the resultant configuration for the LaRC site for Release A. Figure 3.4.2-1 below, provides an overview of the entire configuration and includes the core Ir1 configuration built upon by the Release A required units (shaded components are added at Release A). Although Release-B is an influencing factor in the sizing rationale for the subsystems discussed in detail below, the Release-B hardware is not included in the diagram or in the configuration discussions. Where sizing is based on Release-B considerations, it is explicitly mentioned.

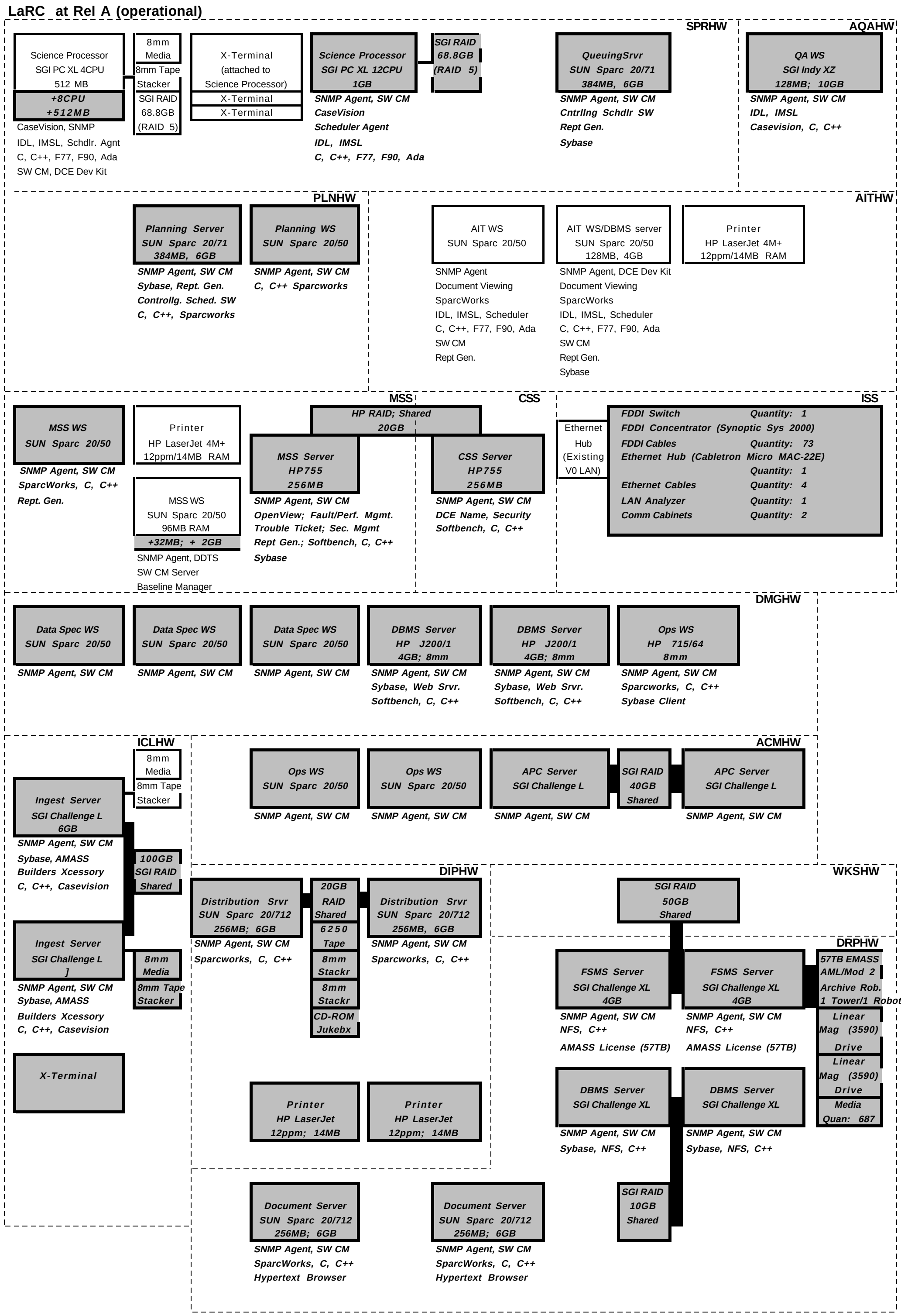

Figure 3.4.2-1. LaRC DAAC Hardware Configuration Overview Diagram

3.4.2.1 Client Subsystem

There is no dedicated hardware support (HWCI) for the Client Subsystem. The Client software configurations are supported by: (1) non-ECS provided hardware platforms, in the case of Client software utilized by the user community, or (2) ECS provided workstations utilizing Client software in support of operations users (network management, DAAC operations, etc.).

3.4.2.2 Data Server Subsystem

During the Release A time frame at the LaRC DAAC, a Data Server configuration is supplied to support TRMM data storage and access services, as well as V0 migration data. The largest data component requiring support in this time frame at LaRC is TRMM CERES. Additional data set storage and access is provided as well and is detailed below. The configuration discussed in the subsections that follow provide a snapshot view of Data Server hardware for Release A; that hardware may be enhanced with additional capabilities for ECS Release B. The Data Server Subsystem configuration provides a LaRC configuration supported by four hardware CIs and is sized for TRMM support for a period of one calendar year beyond TRMM launch date plus V0 data migration for a period of one calendar year beyond initial Release A operations:

- *Access Control & Management (ACMHW HWCI)* -- The access hardware allows for client access (both the client subsystem and direct "push/pull" user access) to the Data Server subsystem, provides tools and capabilities for system administration, and is broken down into two components; Administration Stations (AS) which consist typically of operations support workstations, and Access/Process Coordinators (APCs) which consist of server class machines with host attached RAID disk pools.
- *Working Storage (WKSHW HWCI)* -- Working Storage (WS) hardware of the Data Server supplies a pool of storage used for temporary file and buffer storage within the data Server architecture. During the Release A time frame, this consists of disk storage only (no archive tape and robotics)
- *Distribution and Ingest Peripheral Management (DIPHW HWCI)* -- The hardware of the Distribution and Ingest Peripheral Management supports the hard media distribution methods for data dissemination from the system, as well as hard media ingest of data into the system. The hardware provided by this HWCI includes a variety of media and media drives, jukeboxes/stackers as necessary, and server hosts and disk storage for network distribution.
- *Data Repository (DRPHW HWCI)* -- Data Repositories (DRs) are the hardware components that store and maintain data permanently. For Release A, this consists of DBMS based repositories and archive tape library based repositories. This HWCI provides the disk, server, archive robotics, media and archive tape drives required to support the "permanent" storage repositories.

3.4.2.2.1 Rationale

The following subsystem-wide assumptions were applied in sizing the Data Server hardware components. Data Server Subsystem is sized for TRMM support for a period of one calendar year beyond TRMM launch date plus V0 data migration for a period of one calendar year beyond initial Release A operations. Dynamic modeling was used to size the permanent data repository components, such as the number of robotic arms, tape drives, and production related staging disk. Technical baseline for 1/95 was used both in dynamic modeling as well as in static analysis. User modeling data was used in estimating the user access rates to the system. Table 3.4.2.2-1 summarized the dynamic modeling result for the Data Server components. The table parameters are as follows: Blocking Buffer and DH (Data Handler) disk together constitute the production related disk allocation in the Working Storage disk formula, Archive Station is equivalent to an archive tape drive, Archive Robot is self explanatory.

Table 3.4.2 .2- 1 Synopsis of Relevant Dynamic Modeling Parameters (Epoch E)

Site	Blocking Buffer Usage, max (GB)	DH Disk Usage, max (GB)	Archive Robot Usage, avg	Archive Station Usage
LaRC	16.02	11.02	0.11	0.47

ACMHW Analysis was undertaken primarily for the sizing of the APC server hosts and their attached RAID storage. The administration workstations are assumed to be minimally configured workstations designed to perform various operations functions (e.g. DBMS administration, repository administration, etc.). Client desktop services as well as access to Data Server hosts is the driving sizing factor.

APC server host runs the following software processes and applications: ScienceDataServer Process, ScienceDataServer Administration Process, SubscriptionServer Process, Network ResourceManager Process, PullMonitor Process, CSS DCE client, CSS logging API, and an MSS agent. The anticipated internal I/O to be sustained by the processor averaged over 24 hours of operation is calculated as follows:

I/O = [Distribution of 15.51 GB *(LaRC daily DS production input per day)* / 86,400 *(sec in 24 hrs.) + 20% for ingest + 5% control traffic] *2 (read/write)*

= *0.45 MB/sec nominal load*

Challenge L series I/O bandwidth is 320 MB/sec, which greatly exceeds the requirements, however the same machine will be used in Release B, when the I/O rate is expected to grow by several orders of magnitude.

APC Host Disk -- The APC server host disk is sized for electronic ingest (almost exclusively from sources external to the DAAC), as well as distribution (again, almost exclusively to the recipients external to the DAAC) since this pool of hosts is designed to manage the requests to the Data Server as well as the service response. For Release A, the electronic distribution, as defined within the ECS Technical Baseline for CDR, is "one times" of the total Data Server ingested volume at Release A. It is assumed to occur over a 24-hour period. 48 hours accumulation capacity of 15.51 GB/day at LaRC plus 20% for potential electronic ingest is sized. The total allocated disk capacity rounded upward to the nearest 5 GB is 40 GB.

WKSHW The formula for the total capacity of Working storage disk (adapted to the FSMS host) is sized to deal with the following three categories of staging requirements, which are in turn summed together to provide the site sizing:

- *Production Staging* -- consists of the following items summed together:

  (Modeling Estimate for Maximum Blocking Buffer Requirement)

  + (Modeling Estimate for Maximum Data Handler Disk Usage)

  + (*10%* * (Modeling Estimate for Maximum Data Handler Disk Usage) for failed products)

- In support of Electronic Distribution Staging (transfers to the APC Host's access disk):

  (MAX of [disk space for 1 largest granule requested for distribution from the AHWGP data (3.6 GB) times 4 users {from User Modeling analysis for PDR} (latency of 1/2 hour)]

  or... [minimum FSMS staging cache requirement (8 GB)])

- In support of Electronic Ingest: (transfers from Electronic Ingest into the Data Server):

  + (MAX of [disk space for one largest granule requested for distribution (3.6 GB)]

  or... [% of the ingest storage buffer, see considerations for the APC associated disk])

- In support of Hard Media Distribution/Ingest: (transfers to/from Hard Media Distribution/Ingest into the Data Server):

  + (disk space for one largest granule requested for distribution (3.6 GB))

Thus, for the LaRC configuration, the Working Storage estimate is calculated as follows...

*[Production (16.02) + (11.02) +[Failed Products (0.1*11.02)]] + [Electronic Ingest/Distribution (3.6*4) + (3.6)] + [Hard Media Ingest/Distribution (3.6)] = 49.6 GB ~> 50 GB*

DIPHW The DIPHW configuration at LaRC includes primarily server host and disk units to serve media based distribution production temporary staging (as well as for some types of Ingest as well), and includes a number of peripheral form factors.

Temporary Staging Server Support -- This server is designed to support the media distribution load (as well as a small factor for ingest loads). That is it is designed to handle the I/0 for 1x (one times) distribution of the Data Server ingested volume per twenty-four hours of operation. The platform is sized to handle the network transfer traffic to local disk from the FSMS Server Host source, as well as the media preparation and media ingest I/O. The software processes/applications mapped to this server are: DistributionServer process, ResourceManager Processes for CDROM, various tape, and printers, CSS DCE client, CSS logging API, and an MSS agent. Two server hosts are provided in order to comply with RMA requirements for the function of archiving and distributing data with the required availability of 0.98 and the mean down time not to exceed 2 hours. The hosts are cross-strapped with access to a common pool of staging storage (discussed below). The nominal I/O load to be supported by this platform is calculated as follows for LaRC:

I/O = *[*15.51 *GB (LaRC daily ingest) / 57600 (sec in 16 hrs.) + 10% for ingest] * 2 (read/write)*

= 0.59 M/sec nominal load

The disk associated with the hard media distribution platform is sized for hard media distribution of *1x* (one times) of the total Data Server ingested volume per twenty-four hour operations. Twenty-four hours accumulation capacity, plus ten percent, for potential hard media ingest is sized. The ingest activity is assumed to be negligible, since the Ingest Subsystem is sized to handle the nominal ingest loads both electronically and via media.

Peripheral Support -- The peripherals supported at the LaRC site for Release A were selected based on Level Four requirements: S-DSS-30440, S-DSS-30470, S-DSS-30480 (reference SDPS Requirements Specification for the ECS Project, 304-CD-002-001). Device counts, including jukeboxes, stackers and drives as well are driven primarily by RMA considerations, and less by volume in Release A. The only exception is the single 6250 Tape drive. In the case of 6250, V0 operational experience has shown, that its use as a heritage device is low enough to make the provision of a spare drive unnecessary. In the event of the drive failure the low workload will allow waiting for the drive repair or replacement without a noticeable impact on operations. Additional types of peripherals may be added due to Release B analysis, and the HWCI complement may be easily scaled for both media types as well as capacity. The peripherals supplied here are included in the configuration to primarily support distribution functions. However, the Ingest Subsystem (Ingest Client) residing at LaRC may utilize peripherals to perform some media based ingest, as necessary, based on media form received for storage. This applies only to peripherals not already configured into the Ingest complement for performance reasons.

The types of media form factors/formats selected for Release A include:

- 8mm Tape,
- 6250 Tape (heritage),
- CD-ROM.

The aggregate bandwidth of the peripheral devices exceeds the estimated required bandwidth of media based data distribution and ingest in Release A: LaRC - 0.59 MB/sec (For reference, the throughput rate of a representative 8 mm drive in an uncompressed mode is 3 MB/sec.) The required bandwidth was computed based on the assumption of the hard media distribution equal in volume to one time archive repository ingest: LaRC - 15.5 GB/day, peak and a 16 hours per day operation of the hard media preparation. V0 re-ingest during Release A, constituting 4.16 GB/day at LaRC, is included in these figures.

It is also worthy to note that this HWCI provides the network laser printers for the DAAC DS operations.

DRPHW The DRPHW configuration at LaRC includes both archive based as well as DBMS based physical repositories. They are sized as follows:

Archive Repository -- The archive component was sized through a combination of both static analysis as well as dynamic simulation. The model employed was the dynamic system model, based on a discrete event simulation with constrained resources assumed. Modeling runs based on the January 1995 Technical Baseline were performed. Nominal and peak resource utilization data was used from the model runs and gave specific data regarding disk, tape drive and robotic resource utilization. This data was used in a static sizing analysis synopsized here for LaRC that was coupled with the key driving requirements with respect to distribution (e.g. the x2 distribution cap, the User Model service access predictions for epoch e, 1st Q '98), flow analysis, and data with respect to hardware and software COTS selections.

For the FSMS Manager host server: the platform is selected on the basis of FSMS(AMASS)/platform COTS S/W compatibility. Memory and cache estimates are currently based on vendor recommendations, reference "AMASS Archival Management and Storage System, Installation on Silicon Graphics", EMASS Part Number 600149, AMASS Version 4.2.4, March 1995. Aside from the AMASS FSMS the following processes and applications will run on this server: ResourceManager Process for the staging disk, StagedDataMonitor Process, CSS DCE client, CSS logging API, and an MSS agent. Two server machines (for RMA failover capability) will share access to the Working Storage disk pool.

For the Archive Tape Library Robotics an EMASS Automated Management Library system (Quadro Tower) was selected for Release A based on its ability to accommodate multiple media form factors, storage density, growth capacity, floor space utilization, compatibility with COTS software and a number of other factors. (This selection process is documented in the SDPS Storage Technology Insertion Plan white paper (June 1995, #420-WP-003-001) and is not fully discussed here). Given data with respect to this device (assuming the smallest tower configuration), the dynamic model analysis resulted in a utilization factor for sizing estimation purposes as given below:

LaRC: Configuration: 1 unit Calculated Robotics Utilization: 0.11

For Tape Drives, 3590 (NTP) linear tape drives were assumed for the configuration. The dynamic model runs allocated a number of drives, however the drive utilization for the Release A time frame was shown to be minimal:

LaRC: Calculated Tape Drive Resource Utilization: 0.28

Double the integral quantity is allocated for RMA failover purposes and operational growth within the TRMM mission (sizing here for 1 calendar year).

Media requirements were calculated based on the one year TRMM CERES operations at LaRC, and media to support V0 migration. The total carrying capacity of the archive data repository robotics library (tower system discussed above) to be purchased for Release A at the LaRC site is 57.6 TB, maximum (assuming 3590 technology). Therefore the figures discussed here relate primarily to media piece-count configurations for LaRC ECS V1 operations, and are not limiting factors with respect to the tape library configuration itself. The volume calculations are based on the Technical Baseline of 1/95 for the TRMM product data volumes, on the Technical

Baseline of 6/95 for the V0 migration. It is assumed that the product data cumulates over the 8/97 through 8/98 time period (1 year after TRMM launch). 3590 Cartridge capacity is assumed to be 10 GB maximum capacity, assuming 100% utilization of the media. No compression is assumed. Backup capacity of 20% and a spare tape capacity of 10% are added. For V0 migration the assumption is of migration over time period of 1/96 through 9/97 (Release A activation to Release B activation) of the data sets identified in Tables "Release A Initial Operations" and "Release B Initial Operations". The data sets in the "Release B Initial Operations" Table for where the volume is listed as TBD are not included for sizing. The total calculated media support requirement for CERES and V0 operations is as follows:

(TRMM=4,143 GB) + (V0=1,139 GB) + 20% backup capacity + 10% spare media capacity

= 6,867 GB --> 687 count of 3590 tapes required.

DBMS Repository -- The Data Base Management System (DBMS) Repository component was sized as follows based on static data size analysis as well as transaction based analysis. The transaction analysis is based on both "push" (production metadata update) and "pull" (user access and distribution) loads. Transaction rate was modeled based on the user service request rates as described at PDR time in the User Pull Analysis Notebook, 160-TP-004-001, Question 47 and a cross section of query types derived from the DBMS Benchmark Report, 430-TP-003-001.

The DBMS Server Host was sized based on the transaction analysis mentioned above, as well as platform suitability analysis based on the DBMS COTS software selection for Release A Data Servers (Sybase). Platform suitability is based on the DBMS software manufacturer's compatibility recommendations, benchmark data, and project bench marking activities. Aside from the Data Base engine, the following processes will run on this host: CSS DCE client, CSS logging API, and an MSS agent.

DBMS Server Disk was sized based on to the *core metadata* associated with TRMM CERES data as well that associated with the V0 data sets identified for migration within release A. The data sets identified in Table 3.4.2.2-2 were included. It must be noted, that not all of the included data sets will migrate over the Release A time frame, however, since the ones to migrate have not been fully identified, the entire table is used for a conservative estimate of the metadata volume. The size of the metadata granule for V0 was assumed to be 0.91 KB half that of the full ECS metadata granule of 1.82 KB. That assumption is based on the 50% mapping of V0 attributes to ECS core attributes across all products throughout the Release A duration. Table 3.4.2.2-2 is based on the Science Data Plan.

Table 3.4.2.2 - 2. V0 Data Sets Used to Calculate Migration Metadata Volume Within Release A (1 of 3)

Prod ID	Platform	Inst or Exp	Data Set Name
1A	**(High Priority,**	**High**	**Service [5/4])**
L-3	ERBS, NOAA-9,10	ERBE	S4G - Regional, Zonal, and Global Gridded Averages
L-4	ERBS, NOAA-9,10	ERBE	S4GN - Regional, Zonal, and Global Gridded Averages (Non-scanner only algorithm)
L-8	ERBS	ERBE	S8 - Processed Archival Tape
L-11	NOAA-9	ERBE	S8 - Processed Archival Tape
L-14	NOAA-10	ERBE	S8 - Processed Archival Tape
L-45		ISCCP	Stage C2 Cloud Analysis
L-46		ISCCP	Stage C1 Cloud Analysis
L-48		ISCCP	Stage D2 Product
L-49		ISCCP	Stage D1 Product
L-1	ERBS, NOAA-9,10	ERBE	S4 - Regional, Zonal, and Global Averages
L-5	ERBS, NOAA-9,10	ERBE	S9 - Radiant Exitance and Albedo (Scanner)
L-6	ERBS, NOAA-9,10	ERBE	S10 - Radiant Exitance and Albedo (Non-scanner)
L-20	Nimbus-7	ERB	ERB MATRIX Tape
1A = 13			
1E TBD	**(High Priority,**	**Volume)**	
L-26	SME		Lyman Alpha Solar Irradiance
L-27	SMM	ACRIM	Mean Solar Flux
1E = 2			
2A			**(Medium Priority High Service [5/4])**
L-10	ERBS	ERBE	S7 - Medium/Wide FOV
L-13	NOAA-9	ERBE	S7 - Medium/Wide FOV
L-16	NOAA-10	ERBE	S7 - Medium/Wide FOV
L-28	AEM-2	SAGE I	Aerosol Profile
L-29	AEM-2	SAGE I	NO2 Profile
L-30	AEM-2	SAGE I	O3 Profile
L-33	ERBS	SAGE II	O3 Monthly Average
L-34		SAGE II	Cloud Occurrence
L-35	ERBS	SAGE II	Aerosol Profile
L-36	ERBS	SAGE II	H2O Profile
L-37	ERBS	SAGE II	NO2 Profile
L-38	ERBS	SAGE II	O3 Profile
L-43		SRB	Surface Radiation Budget - Daily
L-44		SRB	Surface Radiation Budget - Monthly
L-51	Aircraft, Ground Sites	FIRE	FIRE_CI1

Table 3.4.2.2 - 2. V0 Data Sets Used to Calculate Migration Metadata Volume Within Release A (2 of 3)

Prod ID	Platform	Inst or Exp	Data Set Name
L-53	Aircraft, Ground Sites	FIRE	FIRE_MS
L-55	Aircraft, Ground Sites	FIRE	FIRE_CI2
L-57	Aircraft, Ground Sites	FIRE	FIRE_ASTEX
L-65	Aircraft, In-situ	GTE	ABLE-3A
L-66	Aircraft, In-situ	GTE	ABLE-3B
2A = 20			
2B			**(Medium Priority, Medium Service [3/2])**
L-2	ERBS, NOAA-9,10	ERBE	S4N - Regional, Zonal, and Global Averages (Non-scanner only algorithm)
L-7	ERBS, NOAA-9,10	ERBE	S10N - Radiant Exitance and Albedo (Non-scanner only algorithm)
L-9	ERBS	ERBE	S2 - Solar Incidence
L-12	NOAA-9	ERBE	S2 - Solar Incidence
L-15	NOAA-10	ERBE	S2 - Solar Incidence
L-41	Nimbus-7	SAM II	Aerosol Extinction Profiles
L-50		ISCCP	Stage Dx Product
L-52	Satellite	FIRE	FIRE_CI1
L-54	Satellite	FIRE	FIRE_MS
L-56	Satellite	FIRE	FIRE_CI2
L-58	Satellite	FIRE	FIRE_ASTEX
L-60	STS-2	MAPS	Tropospheric CO (1981)
L-61	STS-41G	MAPS	Tropospheric CO (1984)
L-21	Nimbus-7	ERB	ERB Solar Irradiance
L-62	STS-59,68	MAPS	Tropospheric CO (1994)
L-63	Aircraft, In-situ	GTE	ABLE-2A
L-64	Aircraft, In-situ	GTE	ABLE-2B
L-67	Aircraft, In-situ	GTE	CITE 3
L-68	Aircraft, In-situ	GTE	PEM-West A
L-69	Aircraft, In-situ	GTE	PEM-West B
L-70	Aircraft, In-situ	GTE	TRACE-A
2B = 21			

Table 3.4.2.2 - 2. V0 Data Sets Used to Calculate Migration Metadata Volume Within Release A (3 of 3)

Prod ID	Platform	Inst or Exp	Data Set Name
2C			**(Medium Priority, Low Service [1])**
L-22	Nimbus-6	ERB	Master Archival Tape (MAT)
L-25	Nimbus-7	ERB	NFOV Orig. MATRIX Tape
L-47		ISCCP	Stage B3 Global Cloud Data
L-59	Satellite	FIRE	FIRE_ETO
L-23	Nimbus-7	ERB	Master Archival Tape (MAT)
L-24	Nimbus-7	ERB	Solar & Earth Flux Data Tape (SEFDT)
L-73			HITRAN Data Base
2C = 7			
2E			**(Medium Priority, TBD Volume)**
L-71	Mauna Loa	Lidar	Stratospheric Aerosols
L-75		ERBE	ERBE Synoptic Product
2E = 2			
3A			**(Low Priority, Low Service [1])**
L-17	ERBS	ERBE	Telemetry and Ephemeris
L-18	NOAA-9	ERBE	Telemetry and Ephemeris
L-19	NOAA-10	ERBE	Telemetry and Ephemeris
L-31	AEM-2	SAGE I	Merged Ephemeris and Radiance Data - MERDAT
L-32	AEM-2	SAGE I	Telemetry and Ephemeris
L-39	ERBS	SAGE II	Merged Ephemeris and Radiance Data - MERDAT
L-40	ERBS	SAGE II	Telemetry and Ephemeris
L-42	Nimbus-7	SAM II	Telemetery and Met. Data
L-76		ISCCP	ISCCP TOVS
L-77		ISCCP	ISCCP Ice/Snow
L-72			Tropospheric O3 Residuals
3A = 11			
3E			**(Low Prority, TBD Volume)**
L-78		GOES	Pathfinder Cloud & Radiance Product
L-79		AVHRR	Pathfinder Atmosphere Product
4E			**(TBD Priority, TBD Volume)**
L-74	Aircraft	AES	AES Products

Table 3.4.2.2-3 is a list of TRMM products used in metadata volume estimates as provided by the DAAC representatives/instrument team.

Table 3.4.2 .2- 3. V1 Data Sets Used to Calculate Metadata Volume Within Release A (1 of 2)

Product	Instrument	Product Description	Platform
CER01T	CERES	Bi-Directional Scan Product (BDS)	TRMM
CERX02TN	CERES	ES-8 ERBE-Like Science Product	TRMM
CERX02T	CERES	ES-8 ERBE-Like Science Product	TRMM
CER03aT	CERES	ES-9 ERBE-Like Product	TRMM
CER09T	CERES	Single Satellite Instrument Earth Scan Product (IES)	TRMM
CER13aT	CERES	ES-4 ERBE-Like Product	TRMM
CER13TA	CERES	ES-4 ERBE-Like Product	TRMM,AM
CER14aT	CERES	ES-4G ERBE-Like Product	TRMM
CER14bTA	CERES	ES-4G ERBE-Like Product	TRMM,AM
CER16T_P	CERES	Clear Reflectance and Temperature History (CRH)	TRMM,PM
CER04aT	CERES	Single Satellite Cloud-Radiation Pixel Product (CRS)	TRMM
CER04aT	CERES	Single Satellite Cloud-Radiation Pixel Product (CRS)	TRMM
CER05aTN	CERES	Hourly Single-Satellite Flux Product (FSW)	TRMM
CER05aT	CERES	Hourly Single-Satellite Flux Product (FSW)	TRMM
CER06aT	CERES	Monthly & Regional Flux Data Product (SRBAVG)	TRMM
CER06bTA	CERES	Monthly & Regional Flux Data Product (SRBAVG)	TRMM,AM
CER07aT	CERES	Synoptic Cloud-Radiation Data Product (SYN)	TRMM
CER07aTA	CERES	Synoptic Cloud-Radiation Data Product (SYN)	TRMM
CER11T	CERES	Single Satellite TOA Fluxes, Surface Fluxes, and Cloud Properties (SSF)	TRMM
CER12TN_V	CERES	Surface and TOA Fluxes (SFC)	TRMM
CER12TN	CERES	Surface and TOA Fluxes (SFC)	TRMM
CER12T_V	CERES	Surface and TOA Fluxes (SFC)	TRMM
CER15aT	CERES	Zonal, and Global Monthly Average Data Product (ZAVG)	TRMM
CER15cTA	CERES	Zonal, and Global Monthly Average Data Product (ZAVG)	TRMM

Table 3.4.2 .2- 3. V1 Data Sets Used to Calculate Metadata Volume Within Release A (2 of 2)

Product	Instrument	Product Description	Platform
CASTR	CERES		TRMM,AM, PM
CCIDA	CERES		TRMM,AM, PM
CCRHA	CERES		TRMM,AM, PM
CER00	CERES		TRMM,AM, PM

The key assumptions associated with the DBMS repository sizing are as follows:

- The products lists have been derived from the ECS Technical Baseline, specifically the AHWGP data.
- The period of data capture is 12/96 (start of Release A) through 9/97 (start of Release B) for V0 metadata migration and 8/97 (TRMM launch date) through 8/98 (1 calendar year from the date of TRMM launch) for TRMM metadata.
- All products are assumed to conform to the Proposed ECS Core Metadata Standard v2.0, 420-TP-001-005, Dec. 1994.
- The metadata sizing has been calculated from the Metadata Expected with each granule table on Page 94 in the Proposed ECS Core Metadata Standard v2.0, 420-TP-001-005, Dec. 1994.
    - The calculated size of 1.823 KB per granule has been obtained from this data source.
- An overhead factor of 2.695 for implementation in Sybase has been estimated based on the bench marking activities as outlined in the DBMS Benchmark Report, 430-TP-003-001.
- An estimated overhead of 153.1 MB will be made for the Sybase application code.

The calculated disk capacity for the LaRC repository (static analysis) results in a computed requirement of 396.7 MB. Due to the operational experience with the user space requirements, at least 5 GB of disk space must be allocated for a high use data base functioning. Therefore, at least 5 GB beyond the calculated storage requirement will be allocated - 6 GB. (The closest available quantity of disk equal or exceeding 6 GB will be purchased.) Dual host configuration will allow for failover.

DOCUMENT DATA SERVER Document handling is handled via a dedicated Data Server implementation, geared to the predicted document ingest and access volumes and the nature of the COTS S/W requirements imposed on the support hardware. The Document Data Server is provided as a simple server configuration with network access. The following assumptions were made in the preparation of the LaRC Document Data Server configuration:

1. Metadata alone has been considered as a basis for the sizing calculations.

2. Due to the non-availability of LaRC and MSFC document sizes, GSFC figures for the Document sizes have been used. Sizing for LaRC is considered to be relatively equal. The CERES ATBD and the LaRC Handbook were used to estimate the additional instrument team documentation.
3. The period for Release A products on the TRMM mission is 8/17/97 to 8/17/98 (we size for one calendar year of TRMM mission support for Release A).
4. The figures are approximations, which will be refined overtime. The Document Data Server architecture is scalable.

A 2 CPU SMP server was selected based upon operational experience with the EDF EDHS. A WAIS-like, full text indexer, an http server, and additional custom developed software will reside on this host. The following processes/applications run on this host: Document Data Server Process, WWW Server Process, Document Repository Process, Client Applications Process, CSS DCE client, CSS logging API, and an MSS agent.

The disk complement was sized to hold the document metadata for the data product collections associated with the TRMM mission, and for the V0 data sets identified for migration. Sizing for document metadata was based on available V0 guide document sizing, and the 2.0 Core metadata baseline. Growth was based on the phased migration of V0 data sets and the TRMM data product collections acquired during Release A operations. The calculated required disk capacity for the document collection alone is 138 MB. (At least 6 GB of usable disk will be purchased as a standard package.)

3.4.2.2.2 Configuration

The specific sizing for the Release A LaRC Data Servers, derived from the rationale described above, is synopsized below. Figure 3.4.2-1 provides the full details for the site's configuration. Additional details on specific component configurations and sizing are provided within the figures (including make and model numbers assumed as candidates for implementation).

For the LaRC Science Data Server....

ACMHW

- Admin. Workstations: 2 ea. of SUN Sparc 20/50
- APC Hosts: two 1 CPU SGI Challenge, configured with 40 GB, minimum, of RAID Disk.

WKSHW

- 50 GB, minimum, of RAID Disk.

DIPHW

- Staging Server Host: two SUN Sparc 20/712, with access to 20 GB disk.
- Standard Release A Peripheral Set: 8mm Tape drives and stackers, 6250 Drive, CD-ROM jukebox.
- Printer: 2 HP Laserjet 4M @ 12ppm, 14MB

DRPHW

- FSMS Server Host: two 1 CPU SGI Challenge XL, which utilizes WKSHW for primary disk
- Archive Tape Library Robotics: 1 AMASS AML Model 2 Tall Quadro Tower system (57 TB capacity with NTP), single robotics
- Tape Drives: 2 NTP 3590 drives
- Tape Media: 687 of 3590 tapes, each at 10 GB capacity including 20% backup capacity and 10% spare tape capacity.
- DBMS Server: two of 2 CPU SGI Challenge XL, with 10 GB of shared disk

For the LaRC Document Data Server....

- WAIS/http Data Server 2 of 2 CPU SMP Server
- Data Server Disk: 6 GB mirrored in two machines for Release A

3.4.2.3 Data Management Subsystem

The Data Management Subsystem (DMS) consists of a single Hardware CI that will also support the processing requirements of the Interoperability Subsystem (IOS) in Release A at the LaRC DAAC site.

The DMS is responsible for Advertising Service CI and Gateway CI DBMS processing activities generated directly from user "pull" service invocations. The DMGHW CI consists of four major components: 1) DBMS/Web Processing Server, 2) Database Management Workstation, 3) Data Specialists Workstations, 4) User Support Workstations.

The DBMS/Web server is the primary HWCI in the Data Management Subsystem. The server contains resources for DBMS storage, input/output (I/O), and processing resources necessary to perform processing functions in support of the Advertising Service CI and Gateway CI databases in Release A. The functionality of the Data Dictionary CI, Local Information Manager CI and Distributed Information Manager CI will be added to the DMGHW CI in Release B.

The DMGHW CI configuration provided in Section 3.4.2.3.2 is specific to Release A, but incorporates Release B platform design issues concerning scalability, evolvability, and migration. The candidate hardware design is tailored to Release A LaRC DAAC specific DBMS processing needs for the Advertising Service CI and Gateway CI databases in support of TRMM mission datasets. Section 3.4.2.3.1, below, provides the rationale behind the recommended configuration which is subject to change as data from the DM components under investigation in the incremental development track (prototyping) becomes available over time.

3.4.2.3.1 Rationale

The performance impact on the DMGHW CI DBMS server hardware in Release A has been determined to be negligible; therefore, the DMGHW CI design reflects sizing, scalability and migration issues that are relevant to Release B in order to avoid unnecessary swap-outs of hardware after Release A. The performance drivers for sizing the DMGHW CI server are:

- User Characterization analysis of science and non-science user service invocations
- DBMS transaction rate analysis
- DBMS prototype/benchmark analysis
- Hardware Scalability, Evolvability and Migration Analysis

User Characterization Analysis User Characterization data provides the projected number of science users, number of non-science users, frequency of search service invocations per time period, and the percentage of invocations for each search service in the Release B time frame. Since the current mission/operations time-line is relatively short between Release A and Release B, it has been determined that the DBMS server platforms be sized according to Release B User Characterization projections. Applying Release B User Characterization Data to the Release A design provides results that are significant to hardware scalability, migration and evolvability issues; therefore, the data provided is projected for the Release B time-frame, but it is applied to the Release A design. For Release A, the primary users that will access the Gateway CI are from the science community, and the primary users that will access the Advertising Service CI are from the non-science community. The following tables summarize the User Characterization service invocation percentages applied to each service (search) type and frequency of service (search) invocations per minute, as documented by the User Characterization Team.

Table 3.4.2.3-1. LaRC User Characterization Service (search) Type for Science Users

Search Type	Fraction of total invocations/year
Simple Search/1 site	0.294
Simple Search/multi-site	0.182
Match-up Search/1 site	0.328
Match-up Search/multi-site	0.194
Coincident Search/1 site	0.00101
Coincident Search/multi-site	.000076

Table 3.4.2.3-2. LaRC User Characterization Service (search) per minute for Science Users

DAAC	Service Searches per minute (busiest time of day)
LaRC	.53355299

The following tables summarize the User Characterization user accesses per day and percentage of service (search) invocations for non-science users, as documented by the User Characterization Team.

Table 3.4.2.3-3. LaRC User Characterization User Accesses per Day for Non-Science Users

DAAC	User Accesses per Day
LaRC	850.390

Table 3.4.2.3-4. LaRC User Characterization Service (search) Type for Non-Science Users

Search Type	Percentage of Total Searches
Simple Search/1 site	60%
Match-up Search/1 site	15%
Coincident Search/1 site	25%

DBMS Transaction Rate Analysis: In order to size the DBMS server it is necessary to estimate the size of the Advertising Service CI and Gateway CI databases and then determine the transaction rates, or database throughput that must be provided in support of the "pull" service activities that are invoked by the user community. The transaction rate analysis is based on assumptions regarding the processing weight that is associated with the six different types of search services that pertain to the Gateway CI and Advertising Service CI databases. Transaction assumptions were made to define transaction loadings per service request. Service requests are provided by the User Characterization Team. The transaction loadings are assumptions and are based on service complexity. The loadings will be refined with actual performance benchmarks as future prototypes are completed. The observed loadings from future prototyping/bench marking activities will then be compared to the predicted ones below and the sizing analysis will be updated as a result (these transaction loading assumptions are defined as "nominal" cases). The transaction data provided is projected for the Release B time-frame, but it is applied to the Release A design; therefore, transactions for the Local Information Manager, Distributed Information Manager, and Data Dictionary CI's are not included in the transaction analysis results.

The primary users of the Gateway CI database are projected to be from the science community. The projected frequency and percentage of science user service invocations are documented in the User Characterization Analysis section above. The following table lists the transaction loadings for the Advertising Service CI and Gateway CI database based on science user service invocations. Searches/hour are calculated for the busiest time of day. The processing (transactions per service invocation) assumptions are based on Advertising Service CI and Gateway CI database preliminary transaction analysis results and will be revised based on future prototyping/bench marking analysis results as they become available.

Table 3.4.2.3-5. LaRC Science User Transaction Loading for Advertising Service CI and Gateway CI Databases

Search Type	Percentage Invoked	Searches/hour worst case	Processing Assumptions (Transactions per Service Type)	Transactions /hour
Simple Search/1 Site	29.4%	9.412	5	47.06
Simple Search/Multi-Site	18.2%	5.826	20	116.528
Match-up Search/1 Site	32.8%	10.500	5	52.502
Match-up Search/Multi-Site	19.4%	6.210	20	124.211
Coincident Search/1 Site	.101%	.03233	5	.1617
Coincident Search/Multi-Site	.0076%	.002433	20	.04866

The following table lists the transaction loadings for the Gateway CI database based on non-science user service invocations as depicted in "User Characterization and Requirements Analysis" (19400312TPW). The table is completed with the assumption that there will be at least five service invocations per access on average.

Table 3.4.2.3-6. LaRC Non-Science User Transaction Loading for Gateway CI Database

Search Type	Percentage Invoked	Searches/hour worst case	Processing Assumptions (Transactions per Service Type)	Transactions /hour
Simple Search/1 Site	29.4%	7.292	5	36.46
Simple Search/Multi-Site	18.2%	4.514	20	90.28
Match-up Search/1 Site	32.8%	8.13	5	40.65
Match-up Search/Multi-Site	19.4%	4.812	20	96.24
Coincident Search/1 Site	.101%	.025	5	.125
Coincident Search/Multi-Site	.0076%	.0019	20	.038

The primary users of the Advertising Service CI are projected to be from the non-science community. The estimated total non-science user accesses per day for the Advertising Service CI is calculated to be 850.390 as depicted in "User Characterization and Requirements Analysis" (19400312TPW). The percentage that each service type, pertaining to the Advertising Service DBMS is invoked, is also taken from "User Characterization and Requirements Analysis" (19400312TPW). The following transaction loading table is completed with the assumption that there will be at least five service invocations per access on average, and that each service invocation produces five transactions for the processor/DBMS. Service invocation transaction ratings will be revised based on future prototyping/bench marking analysis results as they become available.

Table 3.4.2.3-7. LaRC Non-Science User Transaction Loading for Advertising Service CI Database

Search Type	Percentage Invoked	Searches/hour worst case	Processing Assumptions (Transactions per Service Type)	Transactions /hour
Simple Search/1 Site	60%	91.417	5	457.085
Match-up Search/1 Site	15%	22.854	5	114.27
Coincident Search/1 Site	25%	38.09	5	190.45

The following table summarizes science, and non-science user transaction loading per hour for both the Advertising Service CI and Gateway CI Databases.

Table 3.4.2.3-8. DBMS Transaction Summary

DAAC	User Type	DBMS	Searches/hour worst case	Transactions /hour	TPM
LaRC	Science	Gateway/Advertising	31.98	340.511	5.675
LaRC	Non-Science	Gateway	24.774	263.793	4.39
LaRC	Non-Science	Advertising	152.361	761.805	12.697
Totals:			209.115	1366.109	22.762

A sensitivity analysis has been performed with larger loading allocations. The results are shown in Table 3.4.2.3-9.

Table 3.4.2.3-9. DBMS Transaction Sensitivity Analysis Results (loading has been doubled for both service (search) invocations and transaction rates)

DAAC	User Type	DBMS	Searches/hour worst case	Transactions /hour	TPM
LaRC	Science	Gateway/Advertising	63.967	1361.962	22.699
LaRC	Non-Science	Gateway	49.55	1055.172	17.586
LaRC	Non-Science	Advertising	304.182	3041.82	50.697
Totals:			417.699	5458.954	90.982

The transaction per service (search) values for the processing load of the Advertising Service CI and Gateway CI databases are currently assessed as being very small, as depicted in tables 3.4.2.3-8 and 3.4.2.3-9. Future Incremental Track Development prototyping/bench marking activities will provide a more in-depth performance analysis of Advertising Service CI and Gateway CI processes. Furthermore, Local Information Manager CI and Distributed Information Manager CI transaction (rates) loadings are expected to introduce an added, significant processing load on the DMGHW CI DBMS servers in Release B. Performance analysis loadings will be revised according to future prototyping/bench marking results.

DBMS Prototyping/Bench marking Analysis Currently, preliminary Incremental Track Development performance data is being used to size the DMGHW CI DBMS server. Performance analysis results will be revised as planned prototyping/bench marking activities are completed. Future major prototyping activities that will affect performance estimates for the DMGHW CI include the following:

- Gateway CI prototype
- EP6 prototype
- Prototype workshop 2

DBMS performance estimates provided in "DBMS Benchmark Report" technical paper (430-TP-003-001), show that for multi-user (32 users) queries (20 similar queries accessing different parts of the test database) running concurrently, the test-bed CPU, a SUN SPARCstation 20/50, became saturated. A performance comparison of the DBMS benchmark test-bed processor (SUN SPARC 20/50) and the candidate processor (HP J200) for Release A operations is shown in Table 3.4.2.3-10.

Table 3.4.2.3-10. Vendor Platform Performance Estimates

Platform	TPS	MIPS
SUN SPARCstation 20/50 (SMP) with 1 processor	135	133
HP J200 (SMP) with 1 processor (PA 7200 CPU)	240	146

NOTE: As a rule vendor supplied Transaction Per Second (TPS) ratings tend to be a maximum, or high-end value and does not take into account overhead associated with other system processes.

Disk Capacity Sizing Disk storage capacity sizing for the DMGHW CI was determined for each DAAC site based on preliminary DBMS sizing efforts for the Advertising Service CI and Gateway CI operational databases plus vendor inputs for the following COTS software: 1) DBMS software, 2) Development software, 3) HTTP & WAIS server software, 4) Operating System software, 5) Communications and Utilities software. The amount of disk storage needed for the DMGHW CI in Release A is relatively insignificant, as depicted in Table 3.4.2.3-11.

The following table is filled with preliminary sizing results for Release A Interoperability and Data Management operational databases and COTS software packages that will be installed on the DMGHW CI at the LaRC DAAC site. Some of the results are estimates (such as database sizes) since the DBMS design will mature and impact disk capacity sizing as the Advertising Service CI and Gateway CI under-go future evaluation and prototyping.

Table 3.4.2.3-11. DMGHW CI Disk Capacity Requirements

S/W Component	Release A Sizing
COTS Software:	
Open Client	45 MB
SQL Server	60 MB
Replication Server	80 MB
Open Client ESQL/C	26 MB
SQL Monitor Server	1 MB
SA Companion	8 MB
Sybooks	42 MB
	Total: 262 MB
WWW COTS:	
HTTP Server	40 MB (Estimate)
WAIS Server	60 MB (Estimate)
	Total: 100 MB
Databases:	
Advertising Database	150 MB (Estimate)
Advertising DB Workspace	150 MB (Estimate)
Advertising DB Logging	100 MB (Estimate)
Advertising HTML Files	100 MB (Estimate)
WAIS Database	150 MB (Estimate)
Gateway Database	150 MB (Estimate)
	Total: 800 MB

Table 3.4.2.3-11. DMGHW CI Disk Capacity Requirements

S/W Component	Release A Sizing
Operating System & Utilities:	
Operating System Software	700 MB
Utilities	200 MB (Estimate)
DCE Client	40 MB
	Total: 940 MB
	Total: 2.102 GB

3.4.2.3.2 Configuration

The selected DMGHW CI DBMS server to be implemented in Release A is a low-end SMP server. A single CPU configuration has been determined to be appropriate for Release A since light processing loads are expected. Scalability, evolvability and migration issues are determined to be the key design drivers for the DMGHW CI in Release A. The chosen DBMS SMP server is scalable from one to two processors and; therefore, ensures a minimum risk transition from Release A to Release B.

There are two physical DBMS/Web servers that will be implemented at the LaRC DAAC site: the primary, or "active" server and the secondary, or "standby" server. The standby server will house RAID disk that is a mirror set of the DBMS disk devices located on the active server in case of failure to the active servers DBMS disk devices. Looking ahead to Release B, the configuration can be changed to an "active", "active" cluster host configuration. The active/active host configuration would allow for applications to be run in parallel across processors residing in both clustered hosts, which enhances load balancing and availability/recovery capabilities.

Since the Release B processing requirements for the Local Information Manager CI and Distributed Information Manager CI are largely unknown at this time, the flexibility of the recommended design assures minimum risk as the CI processes will most likely introduce significant processing loads to the DMGHW CI DBMS servers. The design also allows for significant growth of the Advertising Service CI in Release B.

A single 8mm tape drive unit will be configured on both active, and standby servers in Release A. The 8mm tape drives will be used to backup Advertising Service CI and Gateway CI databases, as well as perform DBA and routine maintenance operations.

The DMGHW CI DBMS servers will provide four gigabytes of disk drive storage for Release A. Although the estimates for Advertising Service CI and Gateway CI operational databases, COTS software, and operating system and utilities sizing is relatively small, the total disk volume has been bumped up in support of Sybase swap (workspace) area and 100% growth capacity for the base operational software.

A low-end DBMS/DBA workstation will be used in support of database administration, and other M&O activities. A single 8mm tape drive unit will be configured on the DBMS/DBA workstation in Release A. The 8mm tape drive will perform backup/recovery and routine maintenance operations in support of the DMGHW CI DBMS host servers. A small pool of low-end workstations will support Data Specialist/User Support operations. At a minimum the low-end workstations will be configured with two gigabytes of local disk.

Table 3.4.2.3-12 summarizes the DMGHW CI recommended processing configuration for implementation at the LaRC Release A DAAC. The processing configuration is based primarily on scalability, evolvability and migration issues as they have been determined to be the primary design drivers for Release A.

NOTE: The HP J200 SMP shown in table 3.4.2.3-12 is a high-end workstation class server that is scalable from 1-2 CPUs.

Table 3.4.2.3-12. LaRC DAAC Hardware Configuration

Component	Class/Type	Platform	Qty.	Number of Proc.	Disk Capacity
DBMS/Web Server	SMP	HP J200	2	1 (each)	4GB
DBA Workstation	Uni-processor	HP 715/64	1	1	2 GB
Data Specialist and User Support Workstations	Uni-processor	SUN Sparc 20/50	3	1 (each)	2 GB

Technical Specifications for Candidate DBMS Server Platform:

Make: Hewlett Packard

Model: J200 (SMP workstation class server)

CPU: PA7200 (upgradeable to future PA800 processor)

Clock Frequency: 100 MHz

Number of processors: 1 or 2

MIPS: 146

TPS: 240

MFLOPS: 40

SPECint92: 139

SPECfp92: 222

Memory: Expandable to 1 GB RAM

Internal bus bandwidth: 800 MB/sec

3.4.2.4 Ingest Subsystem

Ingest subsystem hardware at LaRC is responsible for the ingest, preprocessing, and storage of TRMM CERES Level 0 data products. Ingest subsystem hardware will also be involved in the migration of existing Version 0 data into ECS Release A. Subsystem configuration and specific component sizing rationale are provided in the following paragraphs.

3.4.2.4.1 Rationale

The sizing of Ingest Subsystem hardware both from a system level and a component level is based on the 6/21/95 version of the ECS Technical Baseline (since system level Dynamic Modeling was not required, use of the 6/21 baseline, for Ingest is allowed). Among the information included in the baseline is:

- data by instrument,
- average daily data volume by level,
- and data destination.

Table 3.4.2.4-1 provides a synopsis of the Ingest data volumes required for Release A at LaRC.

Table 3.4.2.4-1. LaRC DAAC Specific Ingest Volume Requirements;

Release A DAAC	Daily L0 Volume (MB/day)	Annual L0 Volume (GB/year)	Version 0 Data Migration Volume (GB)
LaRC	249	90.1	785

The average expected daily and annual data volumes at each site were calculated from this information and used to determine the required ingest hardware capabilities. Ingest client hosts are sized to accommodate the required ingest volumes as well as I/O and CPU capabilities to support internal data transfers associated with metadata validation and extraction and transfer of data to the Data Server or Processing Subsystems. Working storage disks are sized to accommodate the above functions, as well as provide contingency space for the transfer of more than one days worth of data within a 24-hour period. Since high RMA is a driver for the Ingest Subsystem, all critical components also include some type of sparing or redundancy to ensure that availability requirements are met. It should also be noted that for CDR, the LaRC configuration for Release A is sized for the TRMM mission for one year of operations.

Queuing Analysis Model An Ingest Queuing Model (Imodel) was developed to assist in the sizing of Ingest Subsystem components for the Release A LaRC configuration. This analysis was dependent on a series of model input parameters such as:

- data to be ingested,
- data to be processed,
- data to be stored,

- network component capabilities (assumed at Release A to be FDDI, at 60% efficiency),
- Ingest Subsystem component capabilities (e.g. CPU, I/O, disk I/O, operations per byte).

Data flow sensitivity analysis was conducted with respect to changes in data flows and system architecture (parameters). The load presented by each flow in packets per second is a function of the number of bits per second input from the previous process and the mean size of data set that this process expects. Server host read and write operations have associated transfer rate and access time estimates for each data transfer. Conservative estimates of 2 MB/sec are used based on results from Data Server prototyping efforts. Writing of data to the L0 "rolling store" archive, which in Release A is implemented entirely as disk storage, involves the capabilities of the working storage disks, server I/O, and rolling store devices. Finally, the number of copies of data read from the archive and sent to a data sink (e.g., Processing Subsystem) may be varied to determine the additional load of reprocessing on Ingest Subsystem resources.

Analysis of the ingest queuing model developed for CDR confirms the results of the paper analysis conducted prior to PDR supporting the ability of the Release A Ingest Subsystem configurations to support Level 0 data ingest requirements. Projected maximum individual component utilization in support of Level 0 data ingest is approximately 10% under nominal L0 data ingest operations. The additional subsystem capacity is available for contingency (e.g., ingest of more than one days worth of data in one day or resolving difficulties encountered during reformatting or metadata validation activities), Version 0 data ingest, and subsystem testing requirements. Inclusion of support for Version 0 ingest functions increases subsystem component utilization to the 20% to 40% range, depending on the required daily ingest volume. Select output parameters from the modeling effort for a likely set of input parameters are shown in Figure 3.4.2.4-2. Note that one or more individual flow utilization figures may sum to comprise the total utilization for a particular component. Specifics of the Imodel characteristics and output parameters may be found in the ECS Ingest Subsystem Topology Analysis (440-TP-014-001).

Table 3.4.2.4-2. Queuing Model Derived Requirements for the LaRC Configuration at Release A

Flow	Flow Utilization (% of maximum available)	Time in System (Range for 10 MB - 160 MB file size, in seconds)
Source	4.14	.0006
Working store in	11.67	2.60 - 41.62
Working store out	11.67	2.60 - 41.62
Archive in	7.8	2.60 - 41.62
Archive out	31.14	2.60 - 41.62
Distribution	16.62	.0006

3.4.2.4.2 Configuration

Brief descriptions of the generic components, provided within the LaRC configuration at Release A are provided in Table 3.4.2.4-3. The results of the system design analysis as well at the modeling discussed in Section 3.4.2.4.1, results in a recommended configuration consisting of low to mid-level Symmetric Multi-Processing (SMP) 32-bit machines, capable of supporting multiple network (FDDI) and direct-connect (SCSI II) devices.

Working storage devices are RAID 5 units with a minimum of two days worth of space allocated to ingest working storage required to support the functions of acquiring, processing, validation, and archiving L0 data. This volume of working storage allows for one days worth of L0 data to be staged for processing, an additional days worth available for subsequent ingest, and an additional 25% available to service additional Ingest Subsystem needs (e.g., retrieval support, pre-processing, quality checking). Additional magnetic disk resources are supplied within the Ingest Subsystem to support items such as:

- client host operating system,
- application software and L0 archive database directory information,
- extra capacity to serve as a semi-permanent L0 "rolling storage" archive (no archive robotics and tape media in Release A configurations recommended at this time), and
- inclusion of TRMM spacecraft housekeeping packets in the volume to be stored.

Table 3.4.2.4-3. Ingest HWCI Component Descriptions

Component Name	Class/Type	Comments
Client Host	SMP Server W/S / Server W/S	Single or multi-processor workstation-based servers, up to mid-level SMP servers.
Working Storage	RAID disk	One or more RAID units, site capacity sized. In Release A, this disk buffer acts as temporary staging as well a longer term "rolling storage" (archive) of L0 data (as applicable) in place of tape based and/or archive robotics based storage. RAID 5 for random access protocol.

The specific sizing derived for LaRC Release A requirements is synopsized within Table 3.4.2.4-4 and is highlighted in Section 3.4.2 within the site configuration overview Figure 3.4.2-1. The site overview figure provides additional details on specific component configurations and sizing. The Ingest Subsystem resources at LaRC are sized principally for the operational ingest and storage of CERES Level 0 data sets, and to support the migration of data products from Version 0. Modeling analyses have shown that daily ingest of the CERES Level 0 data consumes less than 10% of ingest subsystem resources. Additional available system resources will be utilized to support the Version 0 data migration effort as discussed in Section 3.4.2.4.1. Details of the migration effort are still being worked out, but preliminary estimates of the system resources required to perform the migration range from 10% to 30%. Additional available system resources are for contingency.

Table 3.4.2.4-4. Ingest HWCI Component Sizing for the LaRC DAAC Configuration

Ingest Component	Component Class	Quantity	Comments
Client Host (ICLHW)	SGI Challenge L SMP	2	L0 Ingest Client hosts. Hosts are adapted to ECOM I/F (FDDI for Release A) and ESN. Host attached disk. SCSI I/Fs to RAID working storage.
(Working Storage)	RAID Disk (host attached)	2	Host adapted RAID disk arrays. RAID 5. SCSI II adapted & cross strapped to Ingest Client hosts. Functions as working storage and L0 rolling store.
Client Host (ICLHW)	8 mm tape stacker	2	Support for hard media ingest
Client Host (ICLHW)	X-Terminal	1	OPS support for Data Ingest Technician(s).

3.4.2.5 Interoperability Subsystem

For the Release A time frame, the hardware support for the Interoperability Subsystem, particularly the Advertising capabilities are provided by the Data Management HWCI. Please see Section 3.4.2.3 for a complete description of this capability.

3.4.2.6 Production Planning Subsystem

The Planning Subsystem consists of a single Hardware Configuration Item (HWCI) providing the hardware resources to support its production planning and plan management for data processing production management (plan implementation) functions. The Planning hardware consists of one or more Production Planning/Management workstation(s) and a Planning (DBMS) server.

The Production Planning/Management server(s) support Planning operations staff in performing their routine production planning and management functions. Workstation(s) are provided for operations personnel access to management GUIs. These functions include candidate plan generation, plan activation, entry of production request information and report generation. The server and workstation classes chosen will be based on projected planning workloads for that DAAC.

The planning and production database is a key component within the Planning subsystem with the database server(s) providing the persistent storage for data which are shared between the applications. The database marshals requests for concurrent access to data and provides the protocols to allow applications to be allocated to distributed platforms.

There are two physical servers: one being the Planning Server and the second being the Production Queuing Server (actually allocated within the SPRHW HWCI). These servers act as the primary and secondary unit, with the Planning Server acting as primary. Both physical servers provide DBMS server capacity.

3.4.2.6.1 Rationale

A basis for the PLNHW capacity sizing is provided in the following paragraphs. Section 3.4.2.6.2, which follows, provides details on site configuration. The Planning Server is provided at Release-A for sites supporting processing operations for TRMM. An the initial estimate for the Planning database sizing and processing loads was made for the Release A and Release B time periods. However, as would be expected, the results of this sizing indicated that a very small system load would be experienced in comparison to the load that would occur during the Release B time period. It was determined that the most cost effective approach for Planning is to select for the Release A period the Planning hardware that would support the Release B workload.

The Planning server supports the Planning database that contains all the information central to the functioning of the Planning Subsystem. To size the Planning server, it is necessary to estimate the size of the Planning database and to determine the database throughput it would have to support (transaction rates).

The size of the Planning subsystem server is estimated by developing a model of the Planning subsystem database and processing loads that would be imposed on the server. The following paragraphs summarize the procedures used, assumptions made and other information used to develop the Planning subsystem workload model for the CDR phase.

1. *Planning DBMS Size* -- The starting point for the sizing effort is the analysis done prior to the ECS PDR for the sizing of the Planning database. This analysis was documented following the PDR in "Planning Subsystem Database Size Estimate for the ECS Project" (440-TP-012-001, February 1995). The fundamental data structures presented in that document remain valid (e.g., PGE Profiles, Production Requests) although some revisions have been within the data structures. For example, parameters within the data structures related to the number of files per job were effected by the initial assumptions made about the average number of files input to or output from a job. More realistic numbers were used.

2. *Technical Baseline* -- The January Technical baseline information was used to derive key parameters that effect the planning and processing workload at each DAAC site. These key parameters include the number of job activations per day for each PGE at each DAAC, the number of input files and output files for the PGEs, and the number of PGEs maintained at each DAAC. For example, at LaRC during the latter end of the Release B period (epoch k, 3Q99), the following parameters are derived:

- No. PGEs at the DAAC	48
- Average number of activations (jobs) per day	305
- Average number of files input to processing per day, all jobs	5,508

- Average number of files output from processing per day, all jobs 2,484
- Average number of files input to an average job per day, per jobs 18
- Average number of files output from processing per day, per jobs 8

3. *OPS Concept* -- At the Operations Concept Workshop held in June 1995 certain concepts were presented concerning the manner in which the Planning subsystem would be used at each DAAC. These assumptions have been adopted here. In summary:

   a. The production scheduler/planner at each DAAC will prepare and publish a 30 day plan every two weeks. This plan is used to provide some assistance in longer range planning. The 30 day plan is only prepared and published every two weeks - if changes occur after a plan is published, the changes will only be incorporated in the next 30 day plan.

   b. The production scheduler/planner at each DAAC will prepare and publish a 10 day plan every week. This plan will provide a finer grain description of planned activities. Like the 30 day plan, this plan will not be replanned and distributed except on the regular weekly boundaries.

   c. The production scheduler/planner at each DAAC will prepare and activate a daily plan or schedule once per day. This schedule will be replanned as required during the course of the day.

   It needs to be noted in this regard, and as is described in more detail in the Planning Subsystem design document, that the manner in which each DAAC operations production scheduler/planner decides to conduct planning and scheduling can vary from DAAC to DAAC. The planning and scheduling tools are sufficiently flexible to support a variety of planning and scheduling strategies. The sizing of the storage and the performance of the server is based upon the assumptions given here. It should also be noted that it is not essential that the operations staff conduct replanning for the active schedule if events arise (e.g., processor failures) that would cause the predictions of the active schedule to depart from reality. Processing will continue regardless since jobs will be released for execution as resources (processors and input data) become available.

4. It was assumed that the reprocessing workload in jobs would be equal to the standard processing workload. Additionally, it was assumed that planning and scheduling in support of testing activities would add an additional 10% to the base workload.

5. Several other parameters were estimated as a part of the process of developing a model for the database sizing and processing activity. Some of these parameters and their values are:

   - No. of working hours per day 16
   - No. of long term (30 day) plans stored 5
   - No. of short term plans stored 5
   - No. of production request per PGE 4
   - No. of replans (active plans) per day 2

6. *Volume Estimates* -- Database storage volume estimates were prepared for each DAAC site by summing each of the database tables as applicable to that DAAC site.

7. *Planning Activities* -- The design for the Planning subsystem was then represented as a collection of several activities or functions (e.g., Subscription Manager, Planning Workbench: Candidate Plan Creation, etc. See Planning Subsystem Design). Functions that were activated only infrequently (e.g., Subscription Submittal) were ignored. The activation frequency of these subsystem activities was then identified, where possible from the January technical baseline summary, for example number of jobs activated per day. Subactivities within these functions were identified and an estimate of the processing load was made based upon the complexity of the activity. These processing load estimates were made in terms of the number of CPU seconds required for a processor estimated to perform at a 1 MIPS rate - i.e. a low end processing system. In one instance for the Processing subsystem, a key parameter (job submission overhead) was used which was measured during bench marking of candidate planning & scheduling subsystems prior to the COTS procurement. Amount of I/O activity was also estimated in terms of records read or written and a CPU load estimate was applied to that value as well. These load estimates were then totaled across the complete set of Planning subsystem activities for the specified frequency of activation for each DAAC site. Planning subsystem server sizing is then estimated by scaling upwards from the base processor size.

RMA analysis performed for the science data production equipment string, does not suggest the need for stringent fail-safe operations. Availability and Mean Down Time (MDT) requirements for the Planning Subsystem function are 0.96 and 4 hours, respectively. Analysis has been performed showing that these requirements are readily met by the Planning Subsystem configuration (Reference: "Availability Model/Predictions for the ECS Project," 515-CD-001-003, July 1995). However, processing must provide a fail soft environment, therefore in terms of mission suitability it is recommended that the configuration remain at two servers (one standby and one primary) to support science data processing.

Since one will act as a backup for the other, two servers, with equal capacities are required due to their role in supporting the production planning and task queuing management functions of the entire DAAC’s processing complement. In the event of failure of the primary host hardware, transition to a secondary host will be facilitated. Since the primary component is the Planning Server, and the Process Queuing Server is backup, each server will be sized to handle both Planning and Process Queuer Server functions. The Process Queuing server is discussed as part of the Science Processing hardware (SPRHW).

DATABASE SIZING Based on the number of activations per day, per PGE, for a given epoch (as established by the January 1995 ECS Technical baseline which incorporates Ad Hoc Working Group on Production (AHWGP) information), the size of the Planning database is estimated for the specific PGEs allocated to that DAAC site. As discussed above, it was assumed that a 30 day plan and a 10 day plan would be produced as described in the June 1995 operations concept workshop.

Based upon the analysis described above, the estimated size of the Planning database to support the CERES processing is currently estimated to be around 2.7 Mbytes total for Release A at LaRC. The major contributors to Release A Planning database size are presented in Table 3.4.2.6-1. Database sizing estimates are relatively low, and it would be impractical to attempt to install a system to support these sizes and workloads. Since the time between initiation of Release-A operations and the beginning of Release-B is short (roughly ten months) and with Release-B hardware installation and preparation overlapping with TRMM operations, our recommended hardware configuration will be based on Release B sizing, not A. The Planning database server will be scaled for 3Q99, Release B by examining Epoch k PGE requirements.

The database sizing estimates are summarized below for the major Planning Subsystem functions for Release B at LaRC within Table 3.4.2.6-1.

Table 3.4.2.6-1. Database Sizing for Release B - LaRC

Sizing Category	Sizing Contribution (kbytes)
PGE Profiles	198.0
Production Requests	27,840.0
DPRs	2498.3
Short Term Plans	269.1
Long Term Plans	805.9
Ground Event Plans	6.4
Data Availability Predictions	1.1
AutoSys Tables	269.1
TOTALS:	*31,887.0*

The total estimated database size at LaRC for Release B is 31.9 MB.

PROCESSING TIMES - The procedure used to develop processing workload estimates is described above. It is essentially a static analysis. Service times for various subfunctions of the Planning and Processing activities were assumed, and an overall workload was computed by this static analysis. Estimates of processing time for the base low-end processor are presented in Table 3.4.2.6-2, which reflect processing times for the Epoch k period at LaRC.

Table 3.4.2.6-2. Processing Time Estimate for Release B - LaRC

Planning Function/Activity	**Estimated Daily Processing Time (sec)**
Subscription Management	2,203
Planning Workbench - Cand. Plan Create	153
- Cand. Plan Activate	63
- Update Active Plan	282
- Cancel/Modify Active Plan	60
COTS Manager	25622
AutoSys Scheduler Reflects: daily schedule update; MSS support; PGE heartbeat; job transitioning; resource management; overhead	20052
AutoXpert	4320
PGE Execution Manager	3154
PGE Data Manager	1360
Total - Planning/Processing	57,269

The desired loading is achieved by scaling from the low-end system performance to the target system performance. Comparative benchmarks for various processing systems have been used to perform the scaling and selection.

It is necessary to consider "critical" or key operational events, however, rather than just a total time and average utilization to determine the adequacy of the design. Two key events occur during the course of the day for the production scheduling personnel: (a) creation of candidate plans, and (b) the candidate plan activation. Based upon the analysis described above, approximately 76 seconds of pure processing time would be expected to produce a short term or 10 day candidate plan. I/O wait time would be of the order of 200 seconds for this epoch at LaRC, resulting in a total time for creation of a candidate plan of approximately 4.6 minutes. Although processing time can be easily corrected for at relatively little additional cost, I/O wait time cannot be so easily or dramatically improved as I/O time. Processing time can easily be reduced to 20% of the base estimate resulting in a total wait time for candidate plan creation of approximately 4 minutes. This is an operationally workable time for an event that might occur 3 or 4 times per day. A similar analysis can be performed for the creation of an active plan. Two components of this event apply - one part for planning and one part for processing management or queuing. Making similar assumptions, it is estimated that activation of a plan would require approximately 100 seconds of processing time and 55 seconds of I/O wait time. Again, processing time can be relatively easily compensated for. With a factor of five improvement in processor speed, the total wait time would be of the order of 75 seconds.

Bench marking and prototyping activities are underway at the time of publication of this document. Information acquired from this process will be used to assess integration issues as well as obtaining more precise performance and capacity measurements, especially in helping to define Release B requirements which pose a more significant load than for A. As the prototypes mature, observed performance characteristics under simulated request load will be used to check / refine / replace the various assumptions made in the sizing efforts.

3.4.2.6.2 Configuration

The Planning Subsystem is a single HWCI providing hardware resources to support production planning and plan management for data processing production management (plan implementation) functions. The Planning hardware consists of a Planning Server and one or more Production Planning/ Management workstations.

The PLNHW server architecture is based primarily on providing facilities with which a common RDBMS for planning and queuing can be serviced. The Planning Server acts as the primary and the Production Queuing Server (allocated within SPRHW) acts as the backup. Both Planning Server and the Production Queuing Server are identical units.

As discussed in the rationale above, database sizing and processing were evaluated for Release A resulting relatively insignificant performance and capacity requirements, therefore the system is configured to support current estimates for Release-B capacity to avoid unnecessary swap-outs of hardware while parallel operations are underway. Since the Release A operations, given the current launch and mission timelines, is relatively short before Release B operations commence, it was determined that the server platforms be sized to Release B requirements for LaRC. As a result, sizing estimation for Release B was undertaken, and this information was used to size the Release A server hardware complement.

Provided capacities for the Planning Subsystem platforms within the configuration are summarized here:

- Planning Server: Sun SPARC 20/71

  - Clock: 75 MHz

  - CPUs: 1

  - Disk: 1 GB base, plus work and swap space for sybase = 6 GB total. *RAID is purchased in 5GB blocks*, therefore 10GB total is provided for Release A and Release B. User workspace and sybase swap space estimates given here are based on experience within the lab, and are subject to refinement as prototyping progresses.

  - RAM: 384 MB

- TPC: Specint92 = 125, Specfp92 = 121

- Planning Workstation: Sun SPARC 20/50

  - Clock: 50 MHz

  - CPUs: 1

  - Disk: 2 GB

  - RAM: 64 MB

  - TPC: Specint92 = 82, Specfp92 = 89

The site configuration overview diagram, Figure 3.4.2-1 depict the PLNHW hardware components at Release A within the context of the overall site configuration.

3.4.2.7 Data Processing Subsystem

The Data Processing Subsystem (DPS) consists of three hardware CIs:

(1) *Science Processing* -- the primary HWCI in the Processing Subsystem and contains staging (working storage), input/output (I/O), and processing resources necessary to perform routine processing, subsequent reprocessing, and Algorithm Integration & Test (AI&T). SPRHW CI consists of two components: Science Processing which provides a pool of cluster configured processing resources, and Processing Queue Management which provides the workstation(s) required to manage, control and status tasked dispatched to the processing resources.

(2) *Quality Assessment and Monitoring (AQAHW)* -- This HWCI contains the hardware necessary to support DAAC operations users performing planned routine QA of product data. At a minimum, the hardware can be configured for general user and subscription use (client support). This HWCI may, over time, consist of QA monitors and workstations ranging from X-terminals, to small user workstations, to medium or large graphics workstations. The complement is site dependent and is a function of the classes of production performed. The need for visualization support will be explored as product specific QA processes and requirements are worked jointly with the DAAC operations personnel as well as the science teams.

(3) *Algorithm Integration and Testing (AI&T)* -- .This HWCI provides the hardware resources to support DAAC operations users performing: science software algorithm integration and test , systems validation and integration and test.. This HWCI provides the workstation and server based operations support hardware, while the prime science software integration and test capacity is provided within the SPRHW HWCI (i.e. no science processors are provided by the AITHW CI to the DAAC configuration). The AITHW HWCI provides the operations support workstations to allow DAAC personnel to configure, control and manage the AI&T processes engaged on the target science processes. AITHW also has provision for a small dedicated DBMS server to support AI&T, which does not interfere with the operational environment

DPS is responsible for managing, queuing, and executing processes on a specified set of processing resources at each DAAC site, and operates in conjunction with the Planning Subsystem.

The overall hardware design for ECS is that of a heterogeneous computing environment. The configuration highlighted here is specifically for Release A (including components provided at Ir1), but factors in requirements with a "look ahead" to Release B for platform suitability, scalability and evolvability. The candidate hardware is tailored to DAAC unique instrument processing needs.

3.4.2.7.1 Rationale

The purpose of the system level performance and capacity analysis is to provide a basis for sizing for Processing, Data Server and Ingest Subsystem capacity as a system. The subsystems are viewed as parts of an integrated system as static and dynamic analysis are applied to generate recommended configurations.

The rationale supplied here addresses SPRHW, AQAHW and AITHW. The sizing for SPRHW focuses heavily on science processor MFLOP, I/O, communications and host attached disk requirements. As indicated above, this analysis meshes with the Ingest, Data Server and Communications sizing, and to a lesser degree with the Planning analysis as well. Rationale for the configuration recommendations are provided below for SPRHW, AQAHW and AITHW in turn below.

WITH RESPECT TO THE SPRHW HWCI: The primary focus is on Release A, two shift operations (i.e. 16 hours a day, 7 days a week or "16/7") at LaRC. In this assumption, no standard processing occurs "lights out" during the third shift. The 16/7 operation at LaRC for CDR represents a baseline change from PDR, which was 24 hours a day operation. Release B performance and capacity are analyzed to understand scalability and migration from Release A to Release B.

The following major driving requirements govern the sizing rationale for the processing hardware:

- RMA requirements,
- capacity phasing (discussed below in detail),
- January 1995 ECS Technical Baseline, incorporating AHWGP estimates
- Hardware suitability (software support, mission support) and scalability
- Parallel AI&T and production operations (at the operational sites)

Release A performance and capacity analysis is based upon the January 1995 Technical Baseline/ AHWGP data. New AHWGP data has been supplied in June 1995 primarily affecting MODIS at GSFC and to a lesser extent CERES and MISR at LaRC. Although this data is being analyzed by the modeling and science team, it has not been applied to the CDR design and analysis described in this volume.

Capacity phasing rules, which are part of the ECS Technical Baseline, are applied to the calculated capacities to produce the required capacities for the particular project phase. A subset of the capacity phasing rules apply to the SPRHW HWCI configuration for LaRC since it is sized for the period extending from launch and full-up Release A TRMM operations, to one calendar year beyond launch (with exception of LaRC Release-B/AM-1 AI&T capacity support, which is resident at the DAAC during TRMM operations):

The following bullets describe the required phasing factors and how they are applied to processing capacity based on launch dates. This phasing is applied to each processing platform.

- **0.3X for L-2 < t < L-1** For pre-launch AI&T starting at launch minus 2 years, AI&T requires 0.3 of the processing estimate at launch during the period 1 to 2 years prior to launch. X is defined as at-launch processing estimate for pre-launch AI&T.
- **1.2X for L-1 < t < L+1** For pre-launch AI&T and system I&T, starting at launch minus 1 year, AI&T and system I&T requires 1.2 times the processing estimate at launch during the year prior to launch. Standard instrument processing requirements begin from launch date and last for the remainder of the life of the instrument. X is defined as at-launch processing estimate for prelaunch AI&T and systems I&T.

LaRC capacity is sized for one (1) year after launch. Therefore, the required processing load one year after launch would be multiplied by a 1.2 X factor, if static analysis were applied above.

Spreadsheet analysis (or static analysis) results are initially presented for Release A (Epoch e) and Release B (Epoch k) sites. Performance and data volume demands are summarized and translated into average processing (MFLOPs), input/output, (I/O) and network bandwidth requirements. The spreadsheet results are time-averaged over the daily operations period.

Dynamic modeling assesses effects of process dynamics including both nominal and peak resource requirements. Both spreadsheet and dynamic modeling results are based upon "one times" (1x) standard processing. Dynamic model results are evaluated for the same Release A and Release B sites, corresponding epochs, and AHWGP data. The Release A dynamic modeling effort focused on the TRMM mission sites: LaRC and MSFC.

STATIC ANALYSIS Table 3.4.2.7-1 below provides a synopsis of the static analysis of the AHWGP requirements for LaRC.

Table 3.4.2.7-1. Static Analysis Summary Results of January 1995 Baseline Data-Release A AHWGP Requirements for LaRC

Instrument	Site	Processing (MFLOPS	Back plane I/O (MBps)	Network I/O (MBps)	Archive I/O (MBps)
CERES	LaRC	4,693	1.8	0.6	0.2

For 16/7 operation at LaRC in Release A, the TRMM CERES machine(s) rated processing requirement, given above accounts for a machine efficiency of 25% (a factor of four was applied to the rolled up numbers). Given here is 1x processing, with no phasing applied. Since TRMM

CERES sizing is based upon processing load one year after launch, the phasing factor applied to processing is 1.2 X. Capacity phasing factors that are applied to the calculated are incorporated into the final sizing given later. The purpose of the static analysis is to provide a check against the Dynamic Analysis, with the later analysis providing the core sizing data for the site configuration. A comparison of the processing figures, to the dynamic peak and nominal predictions is discussed later.

The dominant PGE contributing to processing load is CERES 5AF, which demands 2,672,460 MFLOs and is activated once every hour. However, the backplane I/O estimate is 1.8 MB/sec, average, which is relatively low given the class of machine likely to be applied to satisfy the processing requirement Static analysis provides results that are time averaged over 16 hours as compared to dynamic modeling results that show peaks.

Although Release A is the primary focus, Release B performance and capacity provides a "look ahead" in order to evaluate platform scalability, and assess the impact of algorithm integration and test (AI&T). Capacity requirements for Release B operational sites, for selected instruments, are summarized in Table 3.4.2.7-2 for epoch k (3Q99). As with all static analysis, a 25% assumed efficiency is accounted for (i.e. demand processing is multiplied by a factor of 4) to obtain machine rated MFLOPs.

Table 3.4.2.7-2. Release B Processing, I/O, and Network Bandwidth Requirements Epoch k (3Q99) (January 1995 Baseline)

Instrument/Site	Processing	Backplane I/O (MB/s)	Network I/O (MB/s)
MISR/LaRC	13.84 GFLOPS (46 CPUs)	19.31	6.43
CERES/LaRC	11.32 GFLOPS (38 CPUs)	7.24	2.42
MOPITT/LaRC	71.8 MFLOPS	1.14	0.38

As shown, MISR and CERES instruments at the LaRC site require the largest processing loads for Release B. The purpose of investigating Release B requirement during Release A CDR time period is to project a migration path and satisfy scalability and evolvability to Release B and beyond. The significant increase in the number of CPUs and higher I/O requirements suggest the need for clusters of SMP arrays connected by high performance switches for Release B.

DYNAMIC ANALYSIS The Dynamic Model (ECS System Performance Model) was run to assess dynamic performance of production processing for both Releases A and B. This model provides data with respect to peak and average resource consumption while simulating a resource constrained environment which is not possible with static analysis alone. Static or spreadsheet analysis provides time averaged data over the daily operational period.

Release A was evaluated for TRMM CERES at LaRC during epoch e. The dynamic modeling results are summarized below in Table 3.4.2.7-3 for LaRC primary processing in 2 shift operation. The analysis was performed under a resource constrained configuration.

Table 3.4.2.7-3. Two Shift Operation Performance and Capacity

Max.No. CPUs	MFLOPs/ CPU	Avg. No. of CPUs	Host Disk-Max GB	Host Disk-Avg. GB	DH Disk-Max GB	DH Disk-Avg. GB	Avg. N/W BW to DS MBps
24	300	15.1	31.5	5.7	19.9	1.1	0.65

The mean time to complete the largest TRMM CERES process, (CERES 5AF), is 594.2 minutes (i.e.< 10 hours), including queuing. According to dynamic modeling results, CPU allocation as a function of time, demands a maximum of 24 CPUs with a duty cycle under 50% (based on dynamic run resource consumption plots). The average (nominal consumption) of 15.1 CPUs is indicative of the duty cycle. Typically, there are 3 jobs in queue indicating that the 24 CPUs can readily handle the processing load. Within the runs, host disk usage peaking occurs every ten days at 31.5 GB. Daily peaking is approximately 10 GB with an average of 5.7 GB. The model's "Data handler" (simulation of the Data Server) disk allocation peaks at approximately 20 GB (processing subsystem transfers).

TRMM sizing is based upon processing requirements 1 year after launch. Since epoch e (1Q98) simulated in the dynamic runs, is approximately 6 months after TRMM launch and the duty cycle for CPU allocation is less 50%, it is reasonable not to apply a 1.2 X phasing factor to the predicted Release A complement. Therefore, the required number of CPUs for TRMM CERES should remain at 24.

Dynamic modeling was compared to static modeling results as a cross check. Average processing results compared very favorably, where the average number of CPUs required in 2 shift operation in dynamic modeling was *15.1 CPUs* versus *15.6 CPUs* in static modeling. Similarly, comparison of average network bandwidth of dynamic modeling versus static analysis is very close at 0.65 MBps.

Requirements specify that capacities be allocated to 25% processing, 50% reprocessing, and 25% to the remaining activities including primarily AI&T. Backup to Production processing will be provided by the AI&T science processors in order to support our processing operations fail-soft requirement. Our CPU count configuration recommendation is judged to be adequate for all three categories of support (especially parallel AI&T) for the following reasons:

(1) 24 CPU allocation is peak loading. An average of 15.1 CPUs is required over two shift operation (i.e. 16 hours) or 10.1 CPUs averaged over 24 hours..

(2) Third shift hours are not consumed by standard processing, reprocessing or AI&T. This third shift is considerable contingency capacity for any of these activities, and may be considered as an option by the DAAC.

(3) A single process, CERES 5AF generates the peak load for approximately 10 hours leaving 6 hours available for reuse of unused capacity.

(4) The CPU per platform allocation addresses the concern to support parallel test and operations. Since the class of host recommended for the CERES clusters is a SMP platform, there are issues surrounding shared memory between processors which may be

allocated to AI&T versus true operations. The configuration takes this issue in account as the CPUs are allocated to platforms. The basic rule applied is that a SMP machine is either in AI&T mode or in operations mode, but not split partially across both. (See the configuration section.)

Release B AI&T capacity, which is significant, is resident at LaRC during epoch e to support early AM-1 MISR, CERES and MOPITT activity. Estimates for Release B AI&T, to be present at the LaRC facility within the first year of Release A TRMM operations, are derived from Epoch G using a phasing factor of 0.9. (this phasing factor, *part* of the 1.2 factor, assumes that the Ir1 configuration is already present for this analysis, therefore the 0.9x is used). Release B AI&T processing requirements are summarized in Table 3.4.2.7-4 for CERES-AM1, MISR, and MOPITT.

Table 3.4.2.7-4. Release B AI&T Processing Requirements

Instrument	Processing	No. CPUs*
CERES-AM1	10.76 GFLOPs	35.9
MISR	2.78 GFLOPs	9.3
MOPITT	47 MFLOPs	<1

* Based on 300 MFLOPs machine

It is anticipated that 600 MFLOPs machines will be available in this time frame with corresponding reduced cost. Note that these machines are not shown in the site configuration diagrams and tables for Release A LaRC, since the data provided in this DAAC Specific Volume is geared to address the Release A TRMM mission only.

SENSITIVITY ANALYSIS A combination of sensitivity analysis were performed utilizing dynamic modeling. Fundamentally, the sensitivity analysis explored the effects of the following, alone or in combination:

- higher performance CPUs (e.g. progression from 300 MFLOP units to 600 and 900), and
- effects of 2 versus 3 shifts.

The 300 MFLOPs is a baseline configuration, whereas 600 and 900 MFLOPs are growth cases. An average of 11.54 CPUs are required with peak Host Disk and Data Handler (DH) storage of 27.27 GB and 23.25 GB, respectively. Fewer CPUs are necessary with machines with bigger engines (i.e. higher MFLOPs rating). and mean processing time of the CERES 5AF PGE decreases significantly. 18 CPUs at 300 MFLOPs per CPU can readily handle 24 hour operation. As price/performance and maturity improves, the larger CPU engines are potentially more attractive for future releases.

Two shift operation versus three operation is a trade-off of staffing reduction versus increasing the number of CPUs. The hardware/cost penalty is 6 additional CPUs for two shift operation. Although two shift operation is baseline, this does not preclude the option of processing during unattended operation. The configuration recommended for LaRC assumes two shift operations, utilizing a configuration based on 300 MFLOP CPUs as the core approach.

WITH RESPECT TO THE AQAHW HWCI: The Algorithm Quality Assurance HWCI (AQAHW) contains hardware resources to support DAAC operations users performing planned routine QA of product data. This HWCI facilitates the performance of "DAAC based" QA. While the actual processing resources are included within the SPRHW, this HWCI provides the basic facilities to control and enable QA as a process within each DAAC facility (as needed per site specific science and operational policies).

This HWCI does not necessarily support the other primary forms of QA currently envisioned to be supported by ECS: in line QA and SCF based QA. These forms of QA are supported by other HWCIs as well as subsystems within the SDPS. Capacity to directly support in-line QA is supported by the SPRHW hardware discussed earlier in this section and is considered as part of the ECS Technical Baseline AHWGP information. It is currently assumed that the AHWGP data includes factors for in-line QA and that other forms of QA will be addressed in the future.

QA processing requirements are currently being jointly evaluated with the investigative teams. Current operational assumptions include DAAC QA process performed at the sites in conjunction with SCF-based QA. The current design baseline thus includes local QA monitors for the operational TRMM sites at Release A (that is, those sites which provide for routine standard processing). Sites not providing routine processing as part of TRMM operations do not contain AQAHW unit(s) within their configuration.

Given the boundaries and conditions described above, there are further assumptions which govern the design rationale for this site's AQAHW hardware complement. They are as follows:

- *Type of QA* -- This support is not necessarily equivalent to SCF QA, and the type of support required is a DAAC specific issue.
- *OPS Concept* -- The AQAHW provides client-like access to production data for purposes of time series analysis, visualization checks, report generation, etc. The types of QA to be performed is a function of the instrument and associated production data set characteristics. These local QA monitors are actually similar to Science User workstations equipped with core Client subsystem functionality. These QA monitors, with one or more at a DAAC site, act as QA Clients to the Data Processing components and the Data Server.
- *Software* -- In addition to the core ECS provided software functionality (e.g. client, etc.), the current concept, under investigation, assumes that these QA monitors host Algorithm/Science Team and/or DAAC supplied processes, which use a subset of the ECS services provided primarily by the Data Server and Client subsystems to "pull" production data sets under the *subscription* mechanism, for analysis purposes. These software loads, with respect to memory, disk and processing load cannot be characterized at this time. However, it is likely that if significant processing is required, the QA workstation would not serve as the execution platform, but processing tasks would be dispatched to the SPRHW provided science processors as an option instead.
- *Visualization* -- It is assumed, worst case, that visualization would have to be provided to support the QA. This assumed requirement helps to define the platform type based on the form of data in question.

- *I/O Load* -- Depending upon the operational requirements of the DAAC and the Science Teams (under investigation), this QA can involve full or statistically determined "pull" loads from the production system through the Data Server. Drastically different local data flows can result based on these requirements resulting in differing QA monitoring workstation and communications configurations. These decisions are DAAC specific. However, since requirements are not clear in this area, we have assumed the following for the operational sites:

  Load = 20% of the average daily routine production (e.g. one in five check)

  Therefore...

  LaRC network I/O load = 20% of 3.279 GB/day (across 16 hours)

  = 655.8 MB /day or 11.4 KBps (57 KBps, burst)

  = 91 Kbps nominal network traffic data rate

  This pull load is a fraction of the existing x2 daily distribution supported by the Data Server configuration. We assume the QA load is spread across the operational hours, unique to this site at Release A (that is they are nominal loads).

  Platform I/O is characterized as a multiplier against the assumed network ingest. This multiplier is applied to allow for internal staging and a factor for read/write access to data and to disk in general. The assumption here is:

  *Internal (backplane) I/O = 4 * network I/O rate*

  Therefore....

  *LaRC QA W/S I/O = 4 * 57KBps (peak), 4 * 11.4 KBps (nominal, for 16 hrs.)*

  = < 1 MBps nominal

- *QA Host Disk Storage* -- This is difficult to size accurately at this time due to the uncertainties within the requirements. However, some assumptions are made which are a function of this site's unique processing and data archival requirements. The major disk sizing assumptions are as follows:

  - Must support simultaneous receipt of production "granules" in parallel to supporting ongoing analysis on data already captured. (A multiplier of x2 is assumed here, which is minimal and could be tuned upwards).
  - The largest granule, particular to the site, must be supported.
  - Contingency capacity is supplied to support storage of time series statistics, reports and the like (assumed to be minimal in size).

  *Disk Volume Needed = 2 * [(20% of Daily Production) + Contingency]*

  Therefore....

  Contingency capacity for reporting and tracking is assumed to be 10% for LaRC:

*LaRC QA Disk = [2 * (20% * 3.279 GB/day)] * 1.1*

= 1.4 GB   (less than 5 to 10 GB units)

The large products to be QA'ed in this time frame include:

- *CERES 5AF at 439 MB, with 24 produced per day,*
- *CER 11T at 324 MB, with one produced every hour (16 per day).*

Application of a 5 to 10 GB disk would allow for temporary storage of multiple production set instances, and yet have reserved capacity for report storage and maintenance of time series statistics.

The LaRC requirement for a QA workstation, given the design assumptions above requires a minimally configured graphics workstation with 5 to 10 GB of disk and FDDI network access.

WITH RESPECT TO THE AITHW HWCI: The Algorithm Integration & Test HWCI (AITHW) provides essentially the same configuration at Release A that was provided at Ir1. Operations workstations and a small server are provided to support the AI&T activity, which utilizes AI&T capacity provided by the SPRHW Science Processors to actually host and test the science algorithm software applications. Thus, the AITHW HWCI just provides the operations support workstations to allow DAAC personnel to configure, control and manage the AI&T processes engaged on the target science processors.

The design rationale supplied for the Ir1 components applies, and is not repeated in this volume. AI&T requirements, which increase at Release-A for configurations that were supplied at Ir1, affect the SPRHW hardware CI, not the core of the operations support hardware which is supplied within AITHW. Briefly, the AITHW, sized to support Ir1 and Release A activities, is based on supporting the following:

- Within the AI&T operations workstation:
  - Management and control of AI&T,
  - Compiler suite support, and
  - Report generation.
- Within the AI&T server:
  - Sybase DBMS support (tracking execution profiles, tool kits, data files, etc.),
  - Compiler suite support, and
  - Planning & Queuing test configuration support.

See the site specific design rationale discussion provided earlier within this section for AI&T science processing capacity information as well as the supplied configuration discussed in the section that follows.

3.4.2.7.2 Configuration

The specific provided configurations for the Release A LaRC SPRHW, AQAHW and AITHW HWCIs, as derived from the rationale described above, is synopsized below. Figure 3.4.2-1, which provide the full details for the site's configuration, includes layouts for the Data Processing HWCIs. Additional details on specific component configurations and sizing are provided within the figures (including make and model numbers assumed as candidates for implementation).

Table 3.4.2.7-5 summarizes the *required* capacities vs. the recommended data processing platform's *provided* capacities within the recommended configuration for LaRC. The AHWGP required capacities are derived from the sizing efforts briefly outlined in 3.4.2.7.1 above. Required capacities were modified given the assumptions discussed in the table notes below.

Table 3.4.2.7-5 . Provided Processing Capacity for the LaRC Science Processing Configuration

		AHWGP Required Capacity			Provided Capacity			
DAAC	**Rel**	**MFLOPs**	**Bandwidth**	**Disk Volume**	**Platform**	**Peak MFLOPs**	**Peak I/O Bandwidth**	**Disk Volume**
LaRC	Ir1	1,100	25 MB/sec	30 GB	SMP (4 CPU)	1,200	320 MB/sec	30 GB
	Rel A	+5,632	No Change	+5GB	+SMP (20 CPU)	+6,000	+320 MB/sec	+5GB

(1) ESDIS phasing factors and machine efficiencies are applied.

(2) LaRC required MFLOPs capacities at Ir1 was projected ahead to 6 months after launch (i.e. 1100 MFLOPs), (the MFLOPS provided here are unchanged from PDR)

(3) I/O bandwidth for representative vendor minimum was 25 MB/s and was assumed.

(4) LaRC disk volume estimate, for Ir1, based on DAAC manager estimate, and is unchanged for CDR. Release A disk volume estimates derived from Dynamic Model runs and AHWGP baseline data.

(5) LaRC provided capacities supports 2 shift operation (i.e. 16 hours a day, 7 days a week) for Release A.

(6) LaRC provided capacities for Release A is based upon epoch e AHWGP data.

(7) "AHWGP provided capacity" is based on static analysis. Dynamic analysis was used to derive the "provided capacity".

The Science Processor configuration at Ir1 supplied an SGI Challenge XL based 4 CPU system with 512 MB of RAM. This configuration is augmented at Release A by an additional 20 CPUs, as discussed above, to handle peak CERES TRMM processing. The recommended configuration at Release A is based on a two machine configuration.

The initial configuration analyzed was based on: one machine configured with 18 CPUs (the Ir1 machine with 14 added CPUs and RAM), and a second (new) machine configured with 6 CPUs. Recent work with the LaRC teams is providing background information on RAM utilization (peak and nominal) for the PGEs within the AHWGP information set. This work is preliminary and will require further engineering exchanges to refine, since changes in RAM utilization can affect local I/O, disk utilization and possibly archive drive bandwidth utilization. Based on initial analysis, subject to change, the earlier recommendations of CPU configurations and RAM allocations discussed above was altered. The recommended configuration at this point is:

- Two SGI Power Challenge XL machines,
- Each machine with 12 CPUs (assumed to be 300 MFLOP units, peak),
- Each machine with 1024MB of system RAM (interleaving option, TBR).

Therefore, the Ir1 machine is upgraded from 4 CPUs with an additional 8 CPUs, and an additional 512MB of RAM. This total configuration supplies 24 CPUs and 2 GB of RAM aggregate across two machines for Release A. As indicated in the rationale section, additional AI&T support is supplied all throughout the TRMM first year operations by the Release B AI&T hardware configuration (supporting AM-1 for CERES, MISR, MOPITT). Additional CPU allocation, could, as an option, be brought forward to provide for .50 capacity for reprocessing and .25 for AI&T requirements, as discussed in the rationale section above.

The Process Queuing Server, which serves as the secondary Planning and Queuing Server, is shown in the site overview diagram. It is identical to the primary server, the Planning Server within the PLNHW HWCI.

AQAHW The LaRC requirement for a QA workstation, given the design assumptions above requires a minimally configured graphics workstation with 5 to 10 GB of disk and FDDI network access.

AITHW The LaRC requirement for a AI&T server and OPS workstation doesn't change given that the SPRHW provides the science processing capacity. The Ir1 configuration supplied prior to Release A remains in place and is not augmented further.

3.4.2.8 MSS and CSS Subsystems

The MSS and CSS Subsystem hardware have been sized and configured in a redundant configuration in order to provide for high availability of communications infrastructure and management services. The sizing rationale, therefore, applies to both MSS and CSS servers and will be presented in a single subsection.

The MSS Subsystem consists of a single hardware CI (MSS-HCI), which provides the servers, workstations, and printers needed for all local system management functions. The MSS-HCI provides processing and storage for the following MSS software components:

- Management Software CI (MCI) - provides system monitoring and control (via HP Openview), the database management system (Sybase), trouble ticketing; and management data access (custom code / scripts used to import log file data to the RDBMS)
- Management Logistic CI (MLCI) - Site and SMC maintenance and operations staffs will rely on the Configuration Management Application Service (CMAS) to track ECS baselines; manage system changes; store ECS source code, binaries, test data and documentation; and provide resource version and status information.

- Management Agent CI (MACI) -Agents are processes used to monitor and/or control managed objects distributed across heterogeneous platforms. Current COTS technology for network management uses network protocols such as SNMP to provide a way for the manager, the managed objects, and their agents to communicate. SNMP defines specific messages, referred to as commands, responses, and notifications.

The CSS Subsystem consists of a single hardware CI (CSS-DCHCI), which provides the server for all CSS functionality. CSS contains a single CI, the Distributed Communications CI, which provides the following services:

- Common Facility Services - includes electronic mail, file access, bulletin board, virtual terminal, and event logger services
- Object Services - includes security, naming, message passing, event, thread, time and life cycle services
- Distributed Object Framework - includes OODCE framework functionality.

3.4.2.8.1 Rationale

The MSS/CSS processing complement for LaRC was designed and sized for both the TRMM and AM-1 missions. Storage was sized based on a worst case estimate of LaRC requirements for the TRMM mission (Release A). The sizing of MSS/CSS subsystem hardware is based on the 6/21/95 version of the technical baseline. Storage requirements have been rounded upward.

Processing Requirements Processing requirements for the MSS and CSS subsystem are driven by the following types of transactions:

- HP Openview data collection from managed objects and ad hoc queries (server)
- Conversion / import of HP Openview and log file data to MSS Sybase DBMS (server)
- DBMS usage for report generation / ad hoc queries (server)
- Usage for configuration management, baseline management, trouble-ticketing, and associated report generation (workstation)
- DCE logical server transactions (directory, security, time).

Server Sizing ECS already has experience with many of the COTS products to be loaded on the MSS server from previous work in Evaluation Prototypes (EPs) and EDF installations. Based on this experience, a profile of the MSS/CSS server that is operating under nominal load (e.g., HP Openview map is displayed, but no collections are in process) has been developed. To this, processing requirements have been added for specific types of transactions.

In the EDF, an HP 9000/735/125 (rated at 154 MIPS), equipped with 213 MB RAM was loaded with HP Openview, DCE client, Sybase server, X-server, and operating system. Tests were run to examine the impact of various types of HP Openview functions on CPU utilization. HP Openview was configured to discover approximately 500 nodes within EDF and then displayed them as a node map. Minimal status polling was performed at 15 minute intervals. A variety of HP Openview on-line reports were generated to show such items as packet throughput and CPU utilization. During the testing, processes resident on the server were monitored. CPU utilization remained extremely low (i.e., less than 3%) except during operator queries and initialization. At system start-up, initialization of the various daemons used by HP Openview generated a load of approximately 50%. After start-up, functions that involved initialization of x-windows screens (e.g., generation of the node map or display of a performance graph) generated loads of 25-40% for a brief (less than 15 seconds) period of time. Multiple SNMP queries on a router increased cpu usage to approximately 20 percent, with the primary driver appearing to be the x-windows server. Simultaneous queries of two routers (to two different x-window screens) consumed a total of 50-60% of the cpu. Based on this benchmark, we assume that a basic configuration of a server, including HP Openview, Sybase, DCE client, and the operating system will require approximately 72 MIPS, and will provide adequate resources for routine HP Openview operations. To this must be added processing capacity to handle DCE server functions, HP Openview monitoring, processing of log files, Sybase report generation / ad hoc query capability, Remedy, and mail.

HP Openview and log file-to-Sybase data conversion are primary processing drivers that are expected to vary by DAAC. Table 3.4.2.8.1-3 shows estimated numbers of transactions for HP Openview data collection. HP Openview data collection is driven by the number of managed objects to be monitored and the number of MIB objects to be collected for each. Managed objects for each MIB type were counted based on the Release A CDR hardware plan for LaRC (see Figure 3.4.2-1) and an assumed worst case for Release B. The number and frequency of data collection for each class of managed objects was provided by MSS developers (see 311-CD-003-003, Appendix B). HP Openview provided an estimate of 100,000 instructions per transaction. Using this information, an average number of instructions per second required for HP Openview data collection was developed. These estimates appear to be reasonably in line with HP-provided performance information, which indicates that an HP 9000/735, a machine rated at 125 MIPS, is capable of performing approximately 1300 collections per second.

An estimate of 100,000 instructions per transaction was assumed for the conversion of each logged event to Sybase, based on the number of source lines of code for the MSS MDA component involved and an estimate of instructions needed to update the Sybase database. Instructions per transaction was multiplied by the number of logged events, including both HP Openview events and events collected from applications via the logging API. HP Openview events (transactions) are described in the previous paragraph. The number of application-generated log files, see Tables 3.4.2.8.1-1 and 3.4.2.8.1-2, was developed using the following assumptions:

- One log file (average 192 bytes each) is generated for every system transaction, by every process that is included in the transaction thread.
- The number of “pull” transactions is based on the user model and reflects user service requests by DAAC. Pull transactions (e.g., directory, inventory search requests) are assumed to generate a conservative estimate of 10 log entries each from CIDM and data server processes.
- The number of transactions on the “push” side includes external (DAAC-to-DAAC and L0) file transfers (4 log files each), processing-to-archive requests (4 log files each), and

PGE execution (2 log files each). Push transactions were based on AHWGP data, which showed that LaRC executes 110 PGEs per day and each PGE requires an average of 39 input/output file requests at Release A. At Release B, LaRC executes 326 PGEs, and we assumed the same number of input/output file requests (this was expressed as an hourly average in the tables below for consistency).

- In addition, major processes generate a log file of approximately 512 K (based on the MSS application MIB) once every 15 minutes. There are estimated to be 15 processes at each DAAC that will generate log files every 15 minutes.
- Log files and HP Openview data will be kept for 14 days prior to archiving in long-term Data Server Storage.

The MIPs required to import the total number of log files per day are given in Table 3.4.2.8.1-4.

Table 3.4.2.8.1-1. LaRC Log File Storage Volume - Release A

Log File	Log Events per Transaction	TransactionFrequency per Hour	Total Logged Events per Hour	Bytes per Transaction	Total Size of Bytes/Hr	14-Day Storage Requirements (MB)
User service requests	20	2	40	192	7,680	3
PGE execution	2	5	10	192	1,920	1
External file transfers	4	3	12	192	2,304	1
Processing-to-Archive Requests	4	273	1,092	192	209,664	71
Application MIB poll	15	4	60	512	30,720	10
Total					251,520	86

Table 3.4.2.8.1-2. LaRC Log File Storage Volume - Release B

Log File	Log Events per Transaction	TransactionFrequency per Hour	Total Logged Events per Hour	Bytes per Transaction	Total Size of Bytes/Hr	14-Day Storage Requirements (MB)
User service requests	20	32	640	192	122,880	41
PGE execution	2	14	28	192	5,376	2
External file transfers	4	9	36	192	6,912	2
Processing-to-Archive Requests	4	496	1,983	192	380,640	128
Application MIB poll	15	4	60	512	30,720	10
Total Rel B					539,888	183

Table 3.4.2.8.1-3. LaRC HP Openview Collection Processing Requirement

	# MIB Objects	Average Size (Bytes)	LaRC Managed Objects	Collections per hour*	Collections per second	Estimated MIPS
R-A LaRC (Hosts, RDBMS, Router, hubs)	1,953	4	98	92,832	25	3
R-B LaRC (Hosts, RDBMS, Router, hubs)	1,953	4	392	371,328	103	11

* Note that the number of collections per hour was derived by multiplying each class of MIB objects (e.g., MIB II objects) by the number of managed objects within that class, and summing the results.

Table 3.4.2.8.1-4. MDA Data Conversion to Sybase Processing Requirement

	Total HP Openview Events / Day	Total Log File Events / Day	MIPS for 8 hour Sybase import
Release A	2,227,968	29,136	8
Release B	8,911,872	65,928	31

At Release A, only ad-hoc queries and reports will be generated from the Sybase database, which will be relatively small. Queries are not expected to exert a substantial load on the server. At Release B, an additional workstation may be used as a Sybase server. Sybase performance benchmarks will be run as Release B reporting requirements are defined in order to better analyze server / workstation capacity needs.

DCE has been installed in the EDF and used in the Engineering Prototypes (EPs). Running on an HP 715, rated at 77 MIPS, the DCE server functions used 8% of the CPU, or approximately 6 MIPS. An analysis was performed to determine how much additional load would be placed on the DCE server at Release A and B.

Load imposed on the DCE server is a function of the number of directory, security and time look-ups from client applications. A client application maintains its own cache containing the most recently accessed directory and security information, and will only access the server when a user is not found in its own cache. The client cache is sized at 512 KB or 1/2 percent of the client memory, whichever is greater. This enables storage of approximately 425 directory and security records (a directory record is 1000 bytes; a security record is 200 bytes) at each client. Many client applications will only access other clients within the DAAC, and so will never exceed their cache. CIDM and the Data Server APC, however, will be directly accessed by external user clients and so will need to access directory and security information for each user access. At Release A, given the user baseline of 448 total ECS users, it is unlikely that any client at a single DAAC will exceed its cache storage; therefore, after the initial access for each client, the server may not be accessed again for directory and security information, unless re-initialization occurs. At Release B, the user model reflects a maximum of 32 users accessing a LaRC per hour. Given that a directory and security lookup typically requires less than 0.5 seconds, it is unlikely that there will be more than 1-2 simultaneous hits on the DCE server. We estimate that 1 additional MIP processor capacity will be sufficient for the level of DCE accesses required.

The server requirements, as dictated by the rationale given above, is synopsized in Table 3.4.2.8.1-5.

Table 3.4.2.8.1-5. CSS/MSS Server Configuration - Requirements Estimate

Server Load Sources	Estimated R-A MIPS	Estimated R-B MIPS
Basic configuration (includes HP Openview and DCE client)*	72	72
Additional HP Openview data collection*	3	11
Sybase Server and Client*	30	50
Remedy*	30	30
MDA (log conversion to Sybase)	8	31
MSS Agent*	3	3
DCE server (including additional processing for peak directory and security transactions)*	6	7
Word Processor	1	1
Spreadsheet	1	1
Mail User Interface	3	3
Other Common Services (Mail, file transfer, etc.)*	5	5
Operating System*	6	6
Total (Items with an asterisk were considered to be potentially active at the same time. MDA database update is assumed to be run in off-peak hours, and not concurrently with Sybase report generation functions.)	155	184

Workstation Sizing On the MSS workstation, the biggest drivers will be the MLCI software COTS, including Clearcase, the Software Change Manager, the Inventory Change Manager, and the Baseline Control Manager. In addition, the MSS Workstation will contain the Sybase client, DCE client, MSS agent, and operator tools. Although the CM database will be much larger at the DAACs, it is expected to be more stable than in a development environment, requiring fewer updates and fewer extractions. In the EDF, Clearcase was installed on a SPARCstation 10, equipped with 120 MB RAM, rated at 109 MIPS, and with an ethernet interface. The SPARCstation 10 was initially used for Tool kit development, as well as CM of the Evaluation Prototypes. With moderate numbers of users, the SPARCstation 10 provided good performance. At peak use (15-20 simultaneous users viewing items, manipulating the contents of the database, and executing directly out of Clearcase), performance was adversely affected. Usage at the DAAC is not anticipated to require more than 5 simultaneous users, frequency of use is anticipated to be much lower, and applications will not be executed from the Clearcase tool. Although additional bench marking or analysis will help determine the precise Clearcase processing requirements at the DAAC, EDF experience suggests that a workstation configuration in the SPARCstation 20 range should be adequate to support Clearcase, other MLCI COTS, and DCE and Sybase clients.

Table 3.4.2.8.1-6 below reflects a best estimate of load to be imposed on the MSS workstation at Release A. It assumes that most functions run concurrently. Since two workstations are planned to support MSS functionality at Release A, and additional workstation(s) at Release B, operator functions can be spread across workstations in such a way as to minimize load.

Table 3.4.2.8.1-6. MSS Workstation Configuration - Requirements

Workstation Load Sources	Estimated, R-A and R-B MIPS
Basic configuration (includes Clearcase and Operating System)*	50
Inventory Manager, Change Request Manager, Baseline Manager*	20
Sybase Client*	10
Word Processor	1
Spreadsheet	2
Graphics	1
MSS Agent*	2
DCE Client*	5
Other Common Services (Mail, file transfer, etc.)	5
Total (Items with an asterisk were considered to be potentially active at the same time)	87

Storage Requirements Major datastores for the MSS and CSS subsystems include: HP Openview files, application log files, the Management DBMS, and Clearcase-managed data. Other significant datastores include DCE directory and security data, mail, trouble ticketing database, inventory management database, baseline control database, and software change database.

The size of the data storage for HP Openview has been estimated from the determination of the frequency of transmission of the necessary information of all the appropriate attributes of the managed objects during one hour period. It was assumed that fourteen days worth of HP Openview data are stored.

A description of how application log file volume was estimated is in the previous section (Processing Requirements). Log file volume is provided in Tables 3.4.2.8.1-1 and 3.4.2.8.1-2, based on an assumption of fourteen days storage prior to archiving in the data server archive.

The storage requirement for the Management DBMS was based on a worst case assumption that all the records from both the log files and HP Openview are stored in the Management DBMS, with an additional 10% for table overhead and summarization records. It is assumed that one months worth of data are maintained in the Management DBMS at a time.

Storage requirements for Clearcase are based on the assumption that Clearcase will store, at Release A, two copies of all source code (including ECS application source and algorithms) and two copies of all executables. Storage requirements for source were based on an assumption of This will enable recovery of the previous version of any application if required. In addition, Clearcase will store test data and configuration files. At Release A, the storage requirement for the Sybase DBMS is estimated to be 510 MB, Clearcase 2.9 GB, and 3.1 GB for all other COTS combined. The storage requirement for CSS includes those of directory, security, mail and DCE COTS. Storage requirements for DCE directory and security stores (1Kbyte per record and 200 bytes per record respectively) were derived from the number of Release A users in the technical baseline. The total storage requirements for CSS is estimated to be 1 MB for Release A.

The total storage requirement for Release A is estimated to be between 8 and 10 GB (assuming some additional storage for Sybase swap space). Note that storage is not being estimated for Release B, as shown in Tables 3.4.2.8.1-7 and 3.4.2.8.1.8 below, since RAID disk can be easily added without disruption of operations.

Table 3.4.2.8.1-7. LaRC MSS Release A Storage Requirements

Datastore	Freq. of Events/Hr	Size in Bytes/ Transaction	Size in Bytes Transmitted/Hr	Storage Requirements (MB)
HP Openview Datastore	92,736	5	463,680	156
Application log files	1,180	192*	252,288	85
Sybase DBMS				510
Clearcase				2,907
Other COTS and product executables				3,128
Total Storage Requirement				**6,777**

* Application polling generates 512 byte logs. These have been included in the per hour total.

Table 3.4.2.8.1-8. LaRC CSS Release A Storage Requirements

CSS Data Store	# of Users	Size of Record (# Bytes)	Storage Requirements (MB)
DCE Directory	448	1,000	.04
DCE Security	448	200	0.1
Mail (per day)	87	4,000	0.6
Total Storage Requirement			1

Processor Selection Choice of the MSS/CSS Server platform was based on Release A and Release B processing requirements, COTS to be hosted on the platform, and price/performance data provided by EDS. Based on the Release B processing requirements, a medium-range server class platform (uniprocessor) was chosen. HP is the preferred vendor, since HP Openview and OODCE will be principal COTS products on these platforms, and HP is one of the principal developers of DCE and OODCE.

3.4.2.8.2 Configuration

The following configuration will be provided for the LaRC LSM for Release A, which includes the MSS HWCI and the DC HWCI.

- MSS Local Management Server and CSS Communications Server: 2 HP 9000s755/125 processors, rated at 213 MIPS, 256 MB of RAM and 2 GB of storage.
- RAID Storage: 10 GB storage x 2 RAID partitions for 20GB total
- Workstations:
    - 1 Sun Sparc 20/50 with 130 MIPS, 128 MB of RAM and 4 GB of storage (This workstation will house configuration management software)
    - 1 Sun Sparc 20/50 with 130 MIPS, 64 MB of RAM and 2 GB of storage
    - 1 HP Laser Jet 4M+ Printer, 12 ppm/14 MB.

The LaRC DAAC will contain two primary servers for its LSM configuration, cross-strapped to RAID disk to enable warm backup. MSS and CSS applications will run on separate processors but in case of contingency, either system will be capable of running both subsystems.

The HP 9000s 755/125 is a high performance processor specifically designed for compute intensive and graphic applications. It includes a 213 MIPS processor which will more than support our requirements of 100 MIPS for Release A as shown in Table 3.4.2.8.1-5. Our storage requirements is 8 to 10 GB for Release A. Accordingly, we configured 10 GB of storage along with 755/125.

The configuration at LaRC will include two Sun Sparc 20/50 workstations. One of the workstations which will house configuration management software will be configured with higher memory and higher storage (128 MB of RAM and 4 GB of hard drive).

3.5 Software/Hardware Mapping

With the exception of the Client subsytem, each subsystem has been designed to incorporate hardware CIs that include the components (processors, servers, archive robotics, etc) on which the software components run. While the Interoperability Subsystem includes a hardware CI, Advertising Server (ADSHW), at Release A, the advertising capabilities will be supported on the Data Management HWCI. The Management and Communications subsytems include software components that execute on hardware within these subsystems, as well as on hardware across all the subsystems with hardware CIs. Table 3.5-1 provides a mapping of LaRC ECS Release A software components to the applicable hardware components. See note at bottom of table for mapping of HWCI units to the numbers identified in the table.

Table 3.5-1. LaRC Software to Hardware Analysis (1 of 6)

Subsystem	CSCI	CSC	HWCI /units	NOTES
Client	DESKT	Desktop	5,7,9,12,22,23,26	
Client	WKBCH	Hypertext Viewer CSC	5,7,9,12,22,23,26	
Client	WKBCH	Data Visualization (EOSView) CSC	5,7,12,22,23	
Client	WKBCH	SDPS Toolkit CSC	none	
Client	WKBCH	CSMS Toolkit CSC	none	
Client	WKBCH	Release A Client	none	
CSS	DCCI	File Access Services	29	
CSS	DCCI	Message Passing Services	29	
CSS	DCCI	Time Services	29	
CSS	DCCI	Event Logger Services	29	
CSS	DCCI	Electronic Mail Services	29	
CSS	DCCI	Thread Services	29	
CSS	DCCI	Directory/Naming Services	28	
CSS	DCCI	Life Cycle Services	29	
CSS	DCCI	Security Services	28	
CSS	DCCI	DOF Services	28	
CSS	DCCI	Virtual Terminal Services	28	

Table 3.5-1. LaRC Software to Hardware Analysis (2 of 6)

Subsystem	CSCI	CSC	HWCI /units	NOTES
Data Management	GTWAY	Gateway Server	24	Release A only
Data Management	GTWAY	V0 IMS server	24	Release A only
Data Management	GTWAY	Gateway DBMS	24	Release A only
Data Processing	AITTL	Documentation Viewing Tools	4, 5	
Data Processing	AITTL	Standards Checkers	4, 1	
Data Processing	AITTL	Code Analysis Tools	4, 1	
Data Processing	AITTL	Data Visualization Tools	4, 5	
Data Processing	AITTL	ECS HDF Visualization Tools	4, 5	
Data Processing	AITTL	HDF File Comparison Utility	4, 1	
Data Processing	AITTL	Binary File Comparison Utility	4, 1	
Data Processing	AITTL	Profiling Tools	4, 1	
Data Processing	AITTL	PGE Processing GUI	5	
Data Processing	AITTL	PGE Registration GUI	5	
Data Processing	AITTL	Report Generation Tools	4	
Data Processing	AITTL	SDP Toolkit-related Tools	5	
Data Processing	AITTL	Product Metadata Display Tool	5	
Data Processing	PRONG	Resource Management	2,8(backup), 1	
Data Processing	PRONG	COTS	4 or 5	
Data Processing	PRONG	COTS Management	4 or 5	
Data Processing	PRONG	Data Management	4 or 5	
Data Processing	PRONG	Data Pre-Processing	1	
Data Processing	PRONG	PGE Execution Management	2,8(backup), 1	

Table 3.5-1. LaRC Software to Hardware Analysis (3 of 6)

Subsystem	CSCI	CSC	HWCI /units	NOTES
Data Processing	PRONG	Quality Assurance Monitor	7 (if configured)	
Data Processing	SDPTK	Ancillary Data Access	1, 4	
Data Processing	SDPTK	Celestial Body Position	1, 4	
Data Processing	SDPTK	Coordinate System Conversion	1, 4	
Data Processing	SDPTK	Constant and Unit Conversions	1, 4	
Data Processing	SDPTK	Ephemeris Data Access	1, 4	
Data Processing	SDPTK	Geo Coordinate Transformation	1, 4	
Data Processing	SDPTK	Input/Output	1, 4	
Data Processing	SDPTK	Memory Management	1, 4	
Data Processing	SDPTK	Metadata Access	1, 4	
Data Processing	SDPTK	Process Control	1, 4	
Data Processing	SDPTK	Status Message File (Error/Status)	1, 4	
Data Processing	SDPTK	Time Date Conversion	1, 4	
Data Processing	SDPTK	Math Package	1, 4	
Data Processing	SDPTK	Graphics Library	1, 4	
Data Processing	SDPTK	EOS-HDF	1, 4	
Data Server	DDIST	Distribution Products	14	
Data Server	DDIST	Distribution Client Interface	14	
Data Server	DDIST	Distribution Request Management	14	
Data Server	DDSRV	DDSRV	20	
Data Server	DDSRV	DDSRV Server	20	
Data Server	DDSRV	DDSRV Client	20	
Data Server	DDSRV	DDSRV ESDT	20	
Data Server	DDSRV	DDSRV CSDT	20	

Table 3.5-1. LaRC Software to Hardware Analysis (4 of 6)

Subsystem	CSCI	CSC	HWCI /units	NOTES
Data Server	DDSRV	DDSRV Search Engine	20	
Data Server	SDSRV	Administration/ Operation	13	
Data Server	SDSRV	Client	13	
Data Server	SDSRV	Configuration/Startup	13	
Data Server	SDSRV	Metadata	13	
Data Server	SDSRV	CSDT	13	
Data Server	SDSRV	DB WRPs	13	
Data Server	SDSRV	Descriptors	13	
Data Server	SDSRV	General ESDT	13	
Data Server	SDSRV	Global	13	
Data Server	SDSRV	GUI	13	
Data Server	SDSRV	Non-Product Science ESDTs	13	
Data Server	SDSRV	Non-Science ESDTs	13	
Data Server	SDSRV	Server	13	
Data Server	SDSRV	Subscriptions	13	
Data Server	SDSRV	CERES	13	
Data Server	STMGT	Service Clients	13,14,17	
Data Server	STMGT	Resource Management	13,14,17	
Data Server	STMGT	Data Storage	17	
Data Server	STMGT	Peripherals	13,14,17	
Data Server	STMGT	File	13,17	
Ingest	INGST	Ingest Session Manager	10	
Ingest	INGST	Polling Ingest Client Interface	10	
Ingest	INGST	Ingest Request Processing	10	
Ingest	INGST	Ingest Data Transfer	10	
Ingest	INGST	Operator Ingest Interface	11	(X-term access)
Ingest	INGST	User Network Ingest Interface	30	
Ingest	INGST	Ingest DBMS	10	
Ingest	INGST	Ingest Administration Data	11	
Ingest	INGST	Peripheral Software	10	

Table 3.5-1. LaRC Software to Hardware Analysis (5 of 6)

Subsystem	CSCI	CSC	HWCI /units	NOTES
Ingest	INGST	Viewing Tools	11	
Ingest	INGST	Client Services	10	
Ingest	INGST	Ingest Data Preprocessing	10	
Ingest	INGST	Data Storage Software	10	
Ingest	INGST	Resource Administration	11	
Interoperability	ADSRV	AdvApplDBMSServer	24	Release A only
Interoperability	ADSRV	AdvDBMSServer	24	Release A only
Interoperability	ADSRV	AdvTextServer	24	Release A only
Interoperability	ADSRV	AdvNavigatingServer	24	Release A only
Interoperability	ADSRV	GCMD Exporter	24	Release A only
ISS	INCI	Datalink/Physical		
MSS	MCI	Management Framework	26 or 27	
MSS	MCI	Diagnostic Tests	26 or 27	
MSS	MCI	Application Management	26 or 27	
MSS	MCI	Automatic Actions	26 or 27	
MSS	MCI	Resource Class Category	26 or 27	
MSS	MCI	Performance Manager	27,28	
MSS	MCI	Report Generation and Distribution	27,28	
MSS	MCI	Performance Test	26 or 27	
MSS	MCI	Performance Management Proxy	26 or 27	
MSS	MCI	Security Manager	26 or 27	
MSS	MCI	Security Databases	26 or 27	
MSS	MCI	Tests	26 or 27	
MSS	MCI	DCE Cell Management	26 or 27	
MSS	MCI	Security Management Proxy	26 or 27	
MSS	MCI	Accountability Manager	27,28	
MSS	MCI	User Profile Server	26 or 27	
MSS	MCI	Management Proxy	26 or 27	
MSS	MCI	Physical Configuration Manager	27, 28	
MSS	MCI	Network Manager	27, 28	

Table 3.5-1. LaRC Software to Hardware Analysis (6 of 6)

Subsystem	CSCI	CSC	HWCI /units	NOTES
MSS	MCI	Physical Configuration Proxy Agent	27, 28	
MSS	MCI	Trouble Ticketing Management Services	27,28	
MSS	MCI	Trouble Ticketing User Interface	27,28	
MSS	MCI	Trouble Ticketing Service Requester	26 or 27	
MSS	MCI	Trouble Ticketing Proxy Agent	27,28	
MSS	MCI	Management Data Access Services	26 or 27	
MSS	MCI	Management Data Access User Interface	26 or 27	
MSS	MCI	Ground Events Planning	26 or 27	
MSS	MLCI	Baseline Manager	26 or 27	
MSS	MLCI	Software Change Manager	26 or 27	
MSS	MLCI	Change Request Manager	26 or 27	
MSS	MACI	Extensible SNMP Master Agent	26 or 27	
MSS	MACI	ECS Subagent		
MSS	MACI	DCE Proxy Agent		
MSS	MACI	Encapsulator for non-Peer Agent		
MSS	MACI	SNMP Manager's Deputy		
MSS	MACI	Instrumentation Class Library		
MSS	MACI	Application MIB		
Planning	PLANG	Production Request Editor	2,8	
Planning	PLANG	Subscription Editor	2,8	
Planning	PLANG	Subscription Manager	2,8	
Planning	PLANG	Planning Workbench	2,8	
Planning	PLANG	Planning Object Library	2,8	
Planning	PLANG	PDPS DBMS	2,8	

Note: Unit mapping

1== SPRHW/science processors

2==SPRHW/queuing management server

4==AITHW/AI&T DBMS server

5==AITHW/AI&T Operations workstations

7==AQAHW/QA workstations

8==PLNHW/planning server

9==PLNHW/planning workstations

10==ICLHW/ingest server

11==ICLHW/ingest workstation

12==ACMHW/administration and operations workstations

13==ACMHW/APC servers

14==DIPHW/distribution servers

17==DRPHW/FSMS servers

18==DRPHW/archive robotics

19==DRPHW/DBMS servers

20==DRPHW/document server

22==DMGHW/data specialist workstations

23==DMGHW/administration and operations workstations

24==DMGHW/DBMS servers

26==MSS/MSS workstations

27==MSS/MSS Local System Management server

28==CSS/CSS server

29== all workstations and hosts

30== User workstation

4. Future Releases

This document has described the implementation of ECS subsystems for the LaRC ECS DAAC at Release A. Three other releases are currently planned. The next release, Release B, is scheduled for September 1997. There will be a significant increase in functionality with Release B, as identified in the Release Plan Content Description document. The impact of this functionality on the LaRC ECS DAAC, and other DAACs may be considerable. Release B will be the first release where all of the DAACs are operational. As the system design progresses, the precise nature of the impact on LaRC ECS DAAC can be better determined.

An updated version of this document will precede Release B and will reflect the implementation corresponding to that release. One item is the incorporation of additional data sets as a function of the data migration process, as well as a function of the addition of new instruments. Additionally, a description of some of the enhanced interface functionality follows.

- The interface between the LaRC ECS DAAC and the CERES SCF will be required to support the CERES science software integration and testing of Release 2, the ingesting of the TRMM and AM-1 CERES Level 0 data, the ingesting of ancillary data for the TRMM and AM-1 CERES data processing, the TRMM and AM-1 CERES data processing, the scientific quality assurance for TRMM and AM-1 CERES processing performed by the CERES science team and the CERES data management team, and the distribution of the CERES data to the science community.
- The interface between the LaRC ECS DAAC and the MISR and MOPITT SCFs will be required to support the MISR and MOPITT science software integration and testing of their Release 2, the ingesting of their AM-1 Level 0 data, the ingesting of ancillary data for their data processing, their data processing, the scientific quality assurance for their processing, and the distribution of their data to the science community.
- Interfaces may be required to support the SAGE III Flight-of-Opportunity aboard the Russian Space Agency's METEOR-3M spacecraft. The support for SAGE III's mission is under discussion ; however, the interfaces are not described because the support is not part of the ECS CDR technical baseline.
- The interfaces between the LaRC ECS DAAC and the other DAACs will increase to satisfy the AM-1 instrument data processing (e.g. some MISR ancillary data requirements are snow and ice cover from the NSIDC DAAC and provisional land cover from the EDC DAAC).
- The interface between the LaRC ECS DAAC and the NASDA IP may be required to support the CERES ancillary data requirements (e.g. ADEOS-1/ILAS data from NASDA/EOIS).
- The interface between the LaRC ECS DAAC and the Canadian Space Agency IP may be required to support the MOPITT science software integration and test of Release 2 and MOPITT data processing.

A description of some of the enhanced subsystem functionality follows.

- Data Management–The functionality of this subsystem will be enhanced to incorporate the Local Information Managers (LIM) and data dictionary CSCs. They will contain information concerning the holdings of the LaRC ECS DAAC.
- Data Server–The functionality of the this subsystem will be enhanced. With Release B, the data server subsystem will be able to provide access to additional data types. The subsetting data type service will be provided. It will have the capability to submit and delete data server subscriptions. Suspension and resumption of client sessions will be supported and data access by subscription will be allowed. A multi-tiered storage configuration may be incorporated. The new LaRC ECS DAAC logical data servers for Release B will include:

  1. (80) MISR (Atmos Dyn): This logical data server is required to support the AM-1 MISR science software integration and testing of Release 2 and updated releases and MISR data processing.
  2. (81) MISR (L0/1): This logical data server is required to support the AM-1 MISR science software integration and testing of Release 2 and science software release updates, the ingesting of the AM-1 MISR Level 0 data, and MISR data processing.
  3. (84) MOPITT (L0/1B): This logical data server is required to support the AM-1 MOPITT science software integration and testing of Release 2 and release updates, the ingesting of the AM-1 MOPITT Level 0 data, and MOPITT data processing.
  4. (85) MOPITT (Atmos Comp): This logical data server is required to support the AM-1 MOPITT science software integration and testing of Release 2 and release updates and MOPITT data processing.
  5. (87) SAGE (Atmospheric Products): Based on the above SAGE III discussion, this data server may be required to support SAGE III in addition to SAGE I and SAGE II.
  6. (91) GTE ABLE (Atmos Comp): This data server is required to support Version 0 to Version 1 data migration of GTE ABLE-3A.

In addition to the impacts caused by the addition of ECS capabilities, this document will also change to reflect how certain DAAC issues are addressed and/or resolved. One of these issues is theIdentification of DAAC unique requirements. The preliminary list of LaRC V0 DAAC unique elements follows:

a) LaRC V0 DAAC Special services (see LaRC DAAC Data Migration Plan): IMS, metadata, subsetting, and Read software,

b) LaRC DAAC heritage systems: ERBE processing system, Whitlock's Surface Radiation Budget production system (recently funded Pathfinder research project), and Baum's Pathfinder Cloud Retrieval Algorithm Prototypes (recently funded Pathfinder research project),

c) SAGE III Level 0 processing (tentatively contemplated by SAGE III),

d) LaRC DAAC "live" data sets (see ICD Between ECS and LaRC DAAC): ISCPP DX, SAGE II

e) DAAC-unique tools: databases from LaRC V0 DAAC that allow User Services to maintain a history (e.g., LaRC DOTS).

Other enhancements include the identification of the level of data set migration from V0 to ECS and the clarification of NOAA ancillary data ingest, archive and distribution site(s).

Abbreviations and Acronyms

ACMHW	Access Control and Management HWCI
ADC	Affiliated Data Center
ADS	Archive data sets
ADSHW	Advertising Service HWCI
ADSRV	Advertising Service CSCI
AITHW	Algorithm Integration & Test HWCI
AITTL	Algorithm Integration and Test Tools (CSCI)
AM	Ante meridian
ANSI	American National Standards Institute
APC	Access/Process Coordinators
API	Application Programming Interface
APID	Application Process Identifier
AQAHW	Algorithm QA HWCI
ASAP	As soon as possible
ASCII	American Standard Code for Information Interchange
ASF	Alaska SAR Facility (DAAC)
ATM	Asynchronous Transfer Mode
CD ROM	Compact disk read only memory
CDRL	Contract Data Requirements List
CERES	Clouds and Earth's Radiant Energy System
CI	Configuration Item
CIESIN	Consortium for International Earth Science Information Network
CLS	Client Subsystem
COTS	Commercial off-the-shelf
CPU	Central processing unit
CSC	Computer Software Component
CSCI	Computer Software Configuration Item
CCSDS	Consultative Committee for Space Data Systems

CM	Configuration Management
CSDT	Computer Science Data Types
CSMS	Communications and Systems Management Segment
CSS	Communication Subsystem (CSMS)
DAA	DAN Acknowledge
DAAC	Distributed Active Archive Center
DADS	Data Archive and Distribution System
DAN	Data Availability Notice
DAO	Data Assimilation Office
DAR	Data Acquisition Request
DAS	Data Availability Schedule
DBA	Database administrator
DBMS	Database Management System
DDA	Data Delivery Acknowledgement
DDICT	Data Dictionary CSCI
DDIST	Data Distribution CSCI
DDN	Data Delivery Notice
DDSRV	Document Data Server CSCI
DESKT	Desktop CI
DEV	Developed code
DID	Data Item Description
DIM	Distributed Information Manager
DIMGR	Distributed Information Management CSCI
DIPHW	Distribution & Ingest Peripheral Management HWCI
DMGHW	Data Management HWCI
DMS	Data Management System
DMS	Data Management Subsystem
DP	Data Processing
DPR	December Progress Review
DPREP	Science Data Pre-Processing CSCI
DPS	Data Processing Subsystem

DR	Data Repository
DRPHW	Data Repository HWCI
DS	Data Server
DSM	Distribution Storage Management
DSS	Data Server Subsystem
DT	Data Type
ECS	EOSDIS Core System
EDC	EROS Data Center (DAAC)
EDOS	EOS Data and Operations System
EOS	Earth Observing System
EOSDIS	Earth Observing System Data and Information System
EP	Evaluation Package
EP	Early Prototype
ESDIS	Earth Science Data and Information System
ESDT	Earth Science Data Types
F&PRS	Functional and Performance Requirements Specification
FC	Fiber Channel
FDDI	Fiber distributed data interface
FDF	Flight Dynamics Facility
FOS	Flight Operations Segment
FSMS	File and Storage Management System
Ftp	File transfer protocol
GB	Gigabyte
GDAO	GSFC Data Assimilation Office
GFLOPS	Giga (billions) Floating Point Operations per Second
GOES	Geostationary Operational Environmental Satellite
GRIB	Gridded Binary
GSFC	Goddard Space Flight Center
GTWAY	Version 0 Interoperability Gateway CSCI
GUI	Graphic user interface
HDF	Hierarchical Data Format

HiPPI	High Performance Parallel Interface
HMI	Human machine interface
HTML	Hypertext Markup Language
HWCI	Hardware Configuration Item
I&T	Integration and Test
I/O	Input/Output
IAS	Image Assessment System
ICD	Interface Control Document
ICLHW	Ingest Client HWCI
IDL	Interface Definition Language
IEEE	Institute of Electrical and Electronics Engineers
IERS	International Earth Rotation Service
IGS	International Ground Station
IP	International Partner
IR-1	Interim Release 1
IRD	Interface Requirements Document
IS	Ingest Subsystem
JPL	Jet Propulsion Laboratories
LaRC	Langley Research Center
LIM	Local Information Manager
LIMGR	Local Information Management CSCI
LIS	Lightning Imaging Sensor
L0	Level 0
MB	Megabyte
Mbps	Megabits per second
MBps	Megabytes per second
MD	Maryland
MFLO	Millions of Floating Point Operations
MFLOP	Millions of Floating Point Operations per Second
MOC	Mission Operations Center
MODIS	Moderate-Resolution Imaging Spectrometer

MPP	Massively Parallel Processor
MRF	Medium Range Forecast
MSFC	Marshall Space Flight Center
MSS	Management Subsystem (CSMS)
MTBF	Mean time between failures
MTTR	Mean time to restore
NESDIS	National Environmental Satellite Data and Information Service
NMC	National Meteorological Center
NOAA	National Oceanic and Atmospheric Administration
NSIDC	National Snow and Ice Data Center (DAAC)
O/A	Orbit/Attitude
ODC	Other Data Center
ODL	Object Description Language
ORNL	Oak Ridge National Laboratory (DAAC)
OSM	Open Storage Manager
OTS	Off-the-shelf
PAM	Permanent Archive Manager
PCI	Periphewral Component Interface
PDPS	Planning and Data Processing System
PDR	Preliminary Design Review
PDS	Production Data Set
PDS	Production Data Specialist
PGE	Product Generation Executive
PGS	Product Generation System
PLNHW	Planning HWCI
POSIX	Portable Operating System for UNIX
PRONG	Processing CSCI
Q	Quarter
Q/A	Quality Assurance
QA	Quality Assurance
QAC	Quality and Accounting Capsule

RAID	Redundant Array of Inexpensive Disks
RAM	Random Access Memory
REL	Release
RID	Review Item Discrepancy
RMA	Reliability, Maintainability, Availability
RTF	Rich Text Format
S/C	Spacecraft
SAA	Satellite Active Archives (NOAA)
SCF	Science Computing Facility
SCSI II	Small Computer System Interface
SDF	Software Development File
SDP	Science Data Processing
SDPF	Sensor Data Processing Facility (GSFC)
SDPS	Science Data Processing Segment
SDPS/W	Science Data Processing Software
SDPTK	SDP Toolkit CSCI
SDSRV	Science Data Server CSCI
SFDU	Standard Format Data Unit
SMC	System Management Center
SMP	Symmetric Multi-Processor
SPRHW	Science Processing HWCI
STMGT	Storage Management CSCI
TBD	To be determined
TBR	To be resolved
TDRSS	Tracking and Data Relay Satellite System
TONS	TDRSS Onboard Navigation System
TRMM	Tropical Rainfall Measuring Mission
TSDIS	TRMM Science Data and Information System
UR	Universal Reference
USNO	United States Naval Observatory
V0	Version 0

VC	Virtual Channel
VCDU-ID	Virtual Channel ID
WAIS	Wide Area Information Servers
WAN	Wide Area Network
WKBCH	Workbench CI
WKSHC	Working Storage HWCI
W/S	Workstation
WORM	Write Once Read Many
WS	Working Storage
WWW	World Wide Web